



**Content-Free Cueing and ‘Remembering Goals’ Training:
The Rehabilitation of Prospective Memory Deficits in a
Paediatric Population**

Submitted by Steven Mahan, to the University of Exeter
as a thesis for the degree of Doctor of Clinical Psychology, May 2015

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SCHOOL OF PSYCHOLOGY
DOCTORATE IN CLINICAL PSYCHOLOGY

LITERATURE REVIEW

A Systematic Review of Psychological Interventions to Rehabilitate Prospective Memory

Deficits as a Consequence of Acquired Brain Injury

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A Systematic Review of Psychological Interventions to Rehabilitate Prospective Memory Deficits as a Consequence of Acquired Brain Injury

Abstract

Background: Among the most common and debilitating deficits following acquired brain injury (ABI) are impairments relating to prospective memory (PM). PM is the ability to keep a goal in mind for future action, for example, remembering an appointment. Interventions supporting PM following ABI have the potential to increase independence and enhance social participation.

Objective: The objective of this systematic literature review was to examine the rehabilitation approaches for PM impairments as a consequence of ABI in both adults and children, to establish the interventions that are available or could be adapted to support children with these deficits.

Data Sources: Relevant literature was identified using PsycARTICLES (1894 to present), PsycINFO (1880 to present), the Cochrane Library (1972 to present), and MEDLINE PubMed, in addition to searches on selected references from relevant journal articles and from key journals. Literature searches were conducted using variants of the terms *brain injury, stroke, encephalitis, meningitis, and tumour*, combined with variants of the terms *rehabilitation* and *prospective memory*.

Method: Peer-reviewed journal articles were included. These journal articles investigated interventions and rehabilitation programmes addressing PM outcomes with adults (aged 18-65 years) and/or child and adolescent (aged 0-18 years) participants with a primary diagnosis of ABI. A data extraction sheet was developed based on Cochrane Consumers and Communication Review Group's data extraction template.

Results: Eleven relevant papers were reviewed and demonstrated that a number of varying interventions are available to alleviate PM deficits, including compensatory strategies in the form of external memory aids, which provide either content-specific or content-free cueing, and remediation strategies in the form of meta-cognitive training programmes aimed at improving the self-monitoring and self-evaluation of personal goals.

Critique: Risk of bias for individual studies was considered and the strengths and limitations of each of the included studies and the review itself were discussed.

Conclusions: PM abilities can be improved by utilising simple reminder systems and interventions utilised with adults can be effective; however, paediatric rehabilitation needs to consider on-going cognitive maturation. External strategies aimed to facilitate PM task performance can be generalised to facilitate everyday PM functioning. There is a lack of research of PM interventions conducted in children with ABI, and future research is needed to improve this evidence base.

Keywords: *Prospective Memory, Acquired Brain Injury, Rehabilitation, Intervention*

Introduction

An acquired brain injury (ABI) is a non-degenerative injury to the brain after birth that is not the result of a congenital or a developmental disorder (Appleton, 1998). Brain injuries are thought to be the leading cause of death and disability in children and adolescents (Anderson & Yeates, 2010). In Europe, an aggregate hospitalised and fatal traumatic brain injury (TBI) incidence rate is approximately 235 per 100,000 children and adolescents (Tagliaferri, Compagnone, Korsic, Servadei, & Kraus, 2006). ABIs can be the consequence of external or internal injuries. External injuries, also known as TBI, can be a consequence of a motor vehicle accident, a fall, or an assault; internal injuries can be a consequence of infection (such as encephalitis or meningitis), a cerebral vascular accident (more commonly known as a 'stroke'), or a brain tumour (Bodack, 2010). These pathologies cause distinct neural damage and each present with the potential to alter brain function (Middleton, 2001; Ross, Dorris, & McMillan, 2011).

The frontal lobes, specifically the pre-frontal cortex, are thought to be most vulnerable to damage as a consequence of ABI (Ylvisaker, 1998). Accordingly, among the most common and debilitating deficits following ABI are impairments relating to executive functioning (EF), which refers to higher-order cognitive processes thought to be largely localised to the frontal lobes (Simons, Schölvinck, Gilbert, Frith, & Burgess, 2006; Stuss & Alexander, 2000).

EF refers to the integration of cognitive processes that support goal-directed, purposeful behaviour that are vital for the execution of many daily living tasks (McCauley & Levin, 2004). This includes the ability to anticipate the consequences of actions, the ability to formulate plans, and the ability to monitor, adapt and organise behaviour depending upon the task or context (Burgess, Scott, & Frith, 2003; Duncan, Emslie, Williams, Johnson, & Freer, 1996). Prospective memory (PM) is not a distinct construct, but rather the outcome of a series of cognitive processes, primarily memory

and EF (Fish, Wilson, & Manly, 2010). It refers to the ability to remember to carry out a planned action in the future (Ellis, 1996); this can refer to an event-based action (e.g., remembering to pass on a message), a time-based action (e.g., remembering an appointment), or an activity-based action (e.g., remembering to charge your phone at the end of the day; Kvavilashvili & Ellis, 1996).

To successfully engage in a PM task, it is theorised that one must initially encode and remember the action required. Secondly, an individual is required to recall the action at the necessary time, which involves a dependence on cognitive abilities such as attention and intact executive functioning. One must then execute the action, and finally evaluate the outcome of the action so as to avoid unnecessary repetition of the PM task (Fish et al., 2007).

The rehabilitation of prospective memory. Compensatory interventions are commonly utilised in brain injury rehabilitation settings to alleviate the impact of cognitive deficits on an individual's daily life (Wilson, 2004). They often involve the use of external, prompting memory aids to alleviate the experience of PM deficits, and thus, one's dependence on others to remember daily tasks. These memory aids are often considered as either being passive or active aids (Herrman, Brubaker, Yoder, Sheets, & Tio, 1999). Passive aids are methods of recording the content of a PM task (for example, a 'to-do' list). Although passive aids can be useful, individuals who experience memory complaints may struggle to successfully employ these aids. For example, users of passive aids need to be able to independently remember to self-monitor and amend the content within the aid as necessary, which can impact upon the successful completion of the PM task (Thöne-Otto & Walther, 2008). Conversely, the advantages of utilising active memory aids are that they prompt the user about a PM task or goal, by either alerting the individual using a content-specific cue (e.g., an audio-visual message alert on a smartphone) or alerting the individual about a task using

a content-free cue (e.g., an alarm tone). The advantage of content-free cues, where no specific detail of the PM task is provided, is that the individual needs to only set a standard reminder, rather than input content-specific reminders. Numerous content-specific reminders have the potential to be overwhelming for the recipient, in addition to being laborious for the user to set multiple content-specific reminders every day. Within rehabilitation, other approaches, such as skill training, aim to remediate (rather than compensate for) a lost or, in the case of children, a potentially under-developed skill in the context of an injury. In the context of rehabilitation for PM, the remediation of PM as a skill per se has not been reported; underpinning skills such as metacognition to improve awareness and self-monitoring, however, have been incorporated in to interventions.

Rationale and objective. Evidence is available to suggest that memory and EF systems rarely fully recover following an ABI (Middleton, 2001). It is often considered that, following paediatric ABI (pABI), higher-level cognitive deficits, such as PM, may only become apparent over time when these abilities are expected to develop and mature in a typically developing child. Moreover, PM difficulties will potentially become more noticeable as the child matures, due to children and adolescents being expected to become more independent at home and at school with increasing age (Gamino & Chapman, 2007; Ross et al., 2011). Consequently, interventions supporting PM following ABI have the potential to increase independence and enhance social participation.

The objective of this systematic literature review was to examine the rehabilitation approaches for PM impairments as a consequence of ABI in both adults and children, to establish the interventions that are available or could be adapted to support children with these deficits. To achieve this, the review aims to answer the

following question: What are effective rehabilitation approaches for PM difficulties in individuals with ABIs and which of these could be applied to a paediatric population?

Method

This systematic review was conducted using the PRISMA reporting protocol (Moher, Liberati, Tetzlaff, Altman, & the PRISMA Group, 2009) as this allows for a standardised non-biased approach to the review.

Eligibility criteria. Peer-reviewed journal articles, both group and single-case designs, were included. These journal articles investigated interventions and rehabilitation programmes addressing PM outcomes with adult (aged 18-65 years) and/or child and adolescent participants (aged 0-18 years) with a primary diagnosis of ABI. Eligibility criteria for the systematic review are detailed in Figure 1.

Inclusion criteria:

- (1) Intervention studies addressing prospective memory outcomes
- (2) Peer-reviewed journal articles

Exclusion criteria:

- (1) Articles not addressing intervention
- (2) Articles relating to older adults (65+)
- (3) Theoretical articles or descriptions of rehabilitation programmes with no specific intervention
- (4) Review articles
- (5) Articles without adequate specification of interventions
- (6) Articles that did not include participants with a primary diagnosis of ABI or TBI
- (7) Articles that included participants with a learning disability and/or dementia
- (8) Articles that included participants with a primary diagnosis of Mild-TBI
- (9) Articles describing surgical or pharmacological interventions
- (10) Articles not written in English

Figure 1. The eligibility (inclusion and exclusion) criteria employed for the systematic review.

Information sources. Studies were identified by searching electronic databases, visually scanning reference lists of relevant articles, and searching key journals. The electronic databases PsycARTICLES (1894 to present), PsycINFO (1880 to present), the Cochrane Library (1972 to present), and MEDLINE PubMed (1966 to present) were searched between November 2013 and January 2015. In addition, searches were conducted on selected references from relevant journal articles and from

key journals, including ‘Neuropsychologia’, the ‘Journal of the International Neuropsychological Society’, ‘Developmental Medicine and Child Neurology’, ‘Brain Injury’, ‘Brain Impairment’, and ‘Child Neuropsychology and Developmental Neurorehabilitation’, until January 2015.

Search terms. The following search-terms were used for the systematic review: (1) (“acquired brain injur*” or “acquired head injur*” or “traumatic brain injur*” or “traumatic head injur*” or “brain injur*” or “head injur*” or “stroke” or “cerebral vascular accident*” or “cerebral vascular incident*” or “encephalitis” or “meningitis” or “tumour*” or “tumor*”); (2) (“intervention*” or “rehabilitat*” or “train*” or “therap*” or “strateg*” or “treatment*”); (3) (“prospective memory”). The symbol * relates to database operators, which permit the search of possible extra letters in the term to be included within the search (for example, searching “head injur*” will permit the search of the terms “head injury” and “head injuries”). The three searches were then combined with the database operator ‘AND’.

Study selection and data collection process. The selection for screening eligible records was conducted by the systematic review author alone. A data extraction sheet was developed based on Cochrane Consumers and Communication Review Group’s data extraction template, so that each report could be critiqued, presented and summarised in a clear and concise manner.

Data items. Information was extracted from each record based on: (1) characteristics of study participants (including age and primary diagnosis); (2) the description of the intervention or rehabilitation programme; (3) the outcome measures employed to assess the efficacy of the intervention for alleviating PM difficulties, and; (4) the effect sizes of the intervention, where possible; where it was not possible to determine effect sizes (if mean and standard deviation were not reported), results were provided in the way they were reported in the record.

Risk of bias in individual studies and across studies. To ascertain the validity of eligible records, an appraisal criteria (illustrated in Figure 2) was developed based on Consolidated Standards of Reporting Trials (CONSORT) guidelines, with items added that are specific to ABI (consistent with Ross et al., 2011) and cognitive rehabilitation (consistent with Krasny-Pacini, Chevignard, & Evans, 2014). As this systematic review also included single-case studies, the six CONSORT items that only related to group studies were substituted with items from the SCED rating scale (www.psycbite.com). The SCED scale is used for the evaluation of articles reporting single-case interventions, or intervention studies with small sample sizes (Krasny-Pacini et al., 2014). Each of the 27 items was awarded a score of 1 (if the criterion was met) or 0 (if not met or if was not possible ascertain from information within the article).

In line with Ross et al. (2011) and Krasny-Pacini et al. (2014), articles that met 75% of the criteria specified were considered to be of 'high' quality. Articles that were rated between 50% and 74% were deemed to have 'moderate' quality, and those achieving less than 50% were 'lower' quality (Krasny-Pacini et al., 2014; Ross et al., 2011). The authors of these articles reported that this quality rating was created following a faculty research meeting, due to the lack of available guidance about precise methods of determining the quality and consequent risk of bias in journal articles. Moher et al. (2009) state that it is important to assess the risk of bias within journal articles, and thus, papers with 'high' quality ratings (consistent with Krasny-Pacini et al., 2014; Ross et al., 2011), were deemed to have a reduced risk of bias and, consequently, the findings more empirically sound. Results from records were also examined for information that suggested there may be missing data (publication bias) or missing data from included records (selective recording bias). To determine the reliability of this tool, a second reviewer rated three (27%) of the reports independently. Ratings were identical across all papers (100%).

<p>Score 1 if met, 0 if not met or unable to determine</p> <ol style="list-style-type: none"> (1) Were specific hypotheses and/or objectives stated? (2) Were the settings and locations where data was collected stated? (3) Is the method of randomization appropriate? (4) Was the total sample size >20 participants? (5) Was the total sample size >40 participants? (6) Were at least some of the measures standardized assessment tools? (7) Were the measures appropriate for age group? (8) Did the article specify the severity of the brain injury for participants with acquired brain injury and was the method of diagnosis appropriate (e.g. by a medical professional, Glasgow Coma Scale)? (9) Did the injury occur at least 6mo ago (to ensure the results were not a reflection of the recovery process)? (10) Were follow-up data collected after post-intervention data (i.e. to see if effects were maintained post intervention)? (11) If not, was intent-to-treat analysis used? (Award 1 point if a point is granted on the above item) (12) Were those assessing the outcomes blind to the group? (13) Was the intervention described in detail (i.e. how it was administered, etc.) or was there reference to a manual? (14) Were the characteristics of participants clearly described (e.g. demographic information such as age, sex)? (15) Did the results relate to the initial hypotheses? (16) Was statistical analysis appropriate? (17) Were data adequately described (mean, range etc.)? (18) Were effect sizes calculated? (19) Were effect sizes moderate or larger (for studies with small sample sizes $n < 10$)? (20) Was there sufficient information to calculate effect size (i.e. mean and SD)? (21) Was age taken into account as a possible confounding factor? <p>CONSORT questions applicable to group studies:</p> <ol style="list-style-type: none"> (22) Was a power calculation used or sample size justified? (23) Were the inclusion/exclusion criteria clearly stated? (24) Control or comparison group used? (25) Were participants randomly allocated to groups? (26) Were all participants included in the analysis? (27) Was intention to treat analysis used if randomized? (0 for nonrandomized) <p>SCED questions applicable only to single case studies:</p> <ol style="list-style-type: none"> (22) Was there a clearly defined target behaviour that reflected the cognitive function the intervention aimed at improving? (23) Were sufficient baseline assessments conducted to ensure stability prior to intervention? (24) Was there sufficient sampling during intervention to differentiate a treatment response from fluctuations in behaviour that may have occurred at baseline? (25) Was replication performed? (study on two patients at least)? (26) Was inter-rater reliability of the target behaviour used in baseline and intervention assessed? (27) Did the design allow examination of cause and effect? <p>Total quality rating ___ / 27</p>

Figure 2. The appraisal criteria applied to each record for screening of quality and risk of bias.

Summary measures and planned method of analysis. A reduction in PM memory failures was the primary outcome measure of interest in this systematic review. Where possible, Cohen’s *g* (Cohen, 1988) effect sizes (ES) of pre- and post-intervention PM memory failures were calculated as a standard difference between means, using Hedges *g* (Hedges & Vevea, 1998), which was adapted by Morris and DeShon (2002).

This approach has been utilised (or recommended) in prominent review articles (Cicerone et al., 2005; Krasny-Pacini et al., 2014; Rohling, Faust, Beverly, & Demakis, 2009; Ross et al., 2011) that investigated the efficacy of cognitive intervention, and thus it was deemed appropriate for employment within the current systematic review.

Calculating effect size enables researchers to analyse the magnitude of effects that exist between experimental groups; significance levels simply state if an experimental effect is present rather than the magnitude of effects (Gravetter & Forzano, 2006). ES is separated into boundaries as being a small ($0 < g < 0.2$), medium ($0.2 < g < 0.5$) or large effect ($g > 0.8$). Figure 3 illustrates the formulas for calculating ES. If it was not possible to calculate ES, the record would be analysed based on the results reported within the paper.

The formula below was employed for ES calculation in single group pre- and post-intervention research designs:

$$ES = (M_{\text{post, exp}} - M_{\text{pre, exp}}) / SD_{\text{pre, exp}}$$

The formula below was employed for ES calculation in independent group pre- and post- intervention research designs:

$$ES = \left[(M_{\text{post, exp}} - M_{\text{pre, exp}}) / SD_{\text{pre, exp}} \right] - \left[(M_{\text{post, com}} - M_{\text{pre, com}}) / SD_{\text{pre, com}} \right]$$

In these formulas, *M* is the mean, *exp* is the experimental group, *com* is the comparison group, *pre* is the pre-intervention score, *post* is the post-intervention score, and *SD* is the standard deviation.

Figure 3. The formulas for calculating ES for records included within the systematic review.

Results

Study selection. Figure 4 provides a flow diagram of the search strategy and study selection.

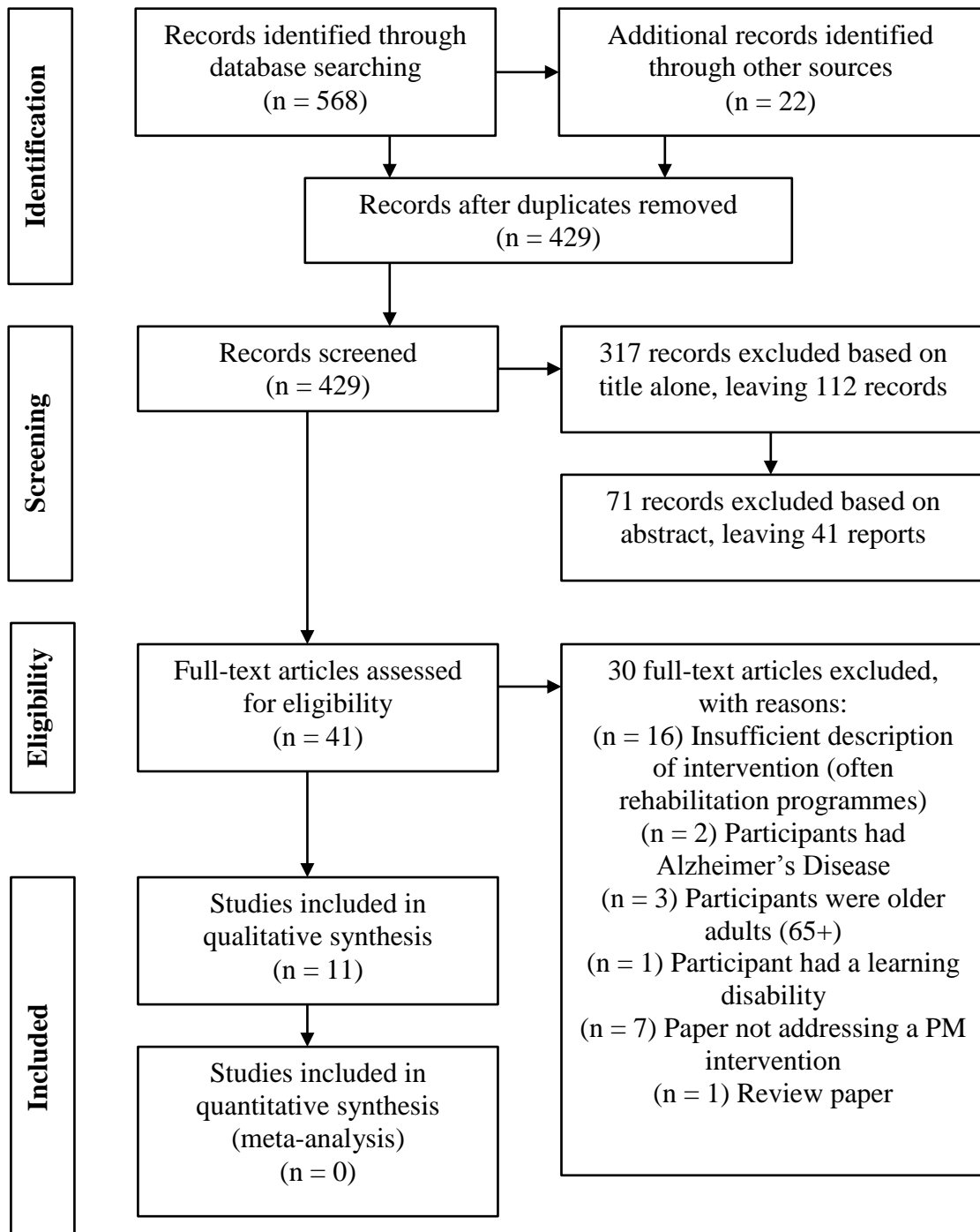


Figure 4. A PRISMA flow diagram detailing the exclusion of papers at each search stage.

Study characteristics. Table 1 summarises and describes the main findings of the studies included in this systematic review pertaining to content-specific compensatory strategies. Table 2 summaries and describes the main findings of the studies included in the review pertaining to content-free and metacognitive strategies. Eight studies (studies 1, 2, 3, 4, 5, 6, 7, and 10) included in the review recruited adult participants (aged 17 to 65 years), two studies (studies 9 and 11) recruited paediatric and adolescent participants (aged 8 to 17 years), and one study (study 8) recruited child, adolescent and adult participants (aged 8 to 65 years). Of these 11 studies, seven studies (studies 1, 2, 6, 8, 9, 10 and 11) employed a single-case design and four studies (studies 3, 4, 5, and 7) employed a group-design. Studies 1 to 9 (seven studies with adult participants aged 18 to 65 years, and two with child, adolescent, and adult participants aged 8 to 65 years) included in the qualitative synthesis pertained to compensatory interventions *only* to alleviate PM difficulties in individuals with ABI. Studies 10 and 11 (one study with adult participants aged 19 to 60 years, and one with paediatric participants aged 8 to 14 years) utilised a hybrid approach; both studies employed a meta-cognitive, remediation training strategy (Goal Management Training; GMT; Duncan, 1986; Levine et al., 2007) *and* a compensatory strategy (content-free cueing) aimed at facilitating the self-monitoring, evaluation and regulation of personal goals. Ten studies achieved a ‘high quality’ rating (77% to 93%); one study (Fish et al., 2007) achieved a ‘moderate quality’ rating (64%).

Content-specific cues. Studies 1 to 9 investigated the efficacy of devices that deliver content-specific cues to alleviate PM task errors in individuals with ABI (seven studies with adult participants aged 17 to 65 years, and two studies with child, adolescent, and adult participants aged 8 to 65 years). These included prompts delivered by a pager, a personal digital assistant (PDA), a Television Assistive

Prompting (TAP) device, the use of Google Calendar, the calendar function on a smartphone, and a device to record voice memos.

Three papers demonstrated that a paging system could be utilised to reduce PM deficits in individuals with TBI. Emslie, Wilson, Quirk, Evans, & Watson (2007) demonstrated this with adult participants (aged 30 to 49 years). Wilson, Emslie, Quirk, Evans, & Watson (2005) and Wilson et al. (2009) demonstrated this with child, adolescent and adult participants (aged 8 to 65 years). All three studies showed evidence to suggest that PM task performance improved when receiving content-specific pager prompts.

An increase in PM task success has also been demonstrated in studies with adult participants (aged 17 to 65 years) utilising PDA devices as external memory aids (Lannin et al., 2014; Waldron, Grimson, Carton, & Blanco-Campal, 2012). Lannin et al. demonstrated that PDA devices with an alerting function facilitate memory functioning better than non-electronic memory aids. A Televised Assisted Prompting (TAP) system has also been shown to be a unique compensatory strategy for PM failures in adult participants aged 18 to 60 years (Lemoncello, Sohlberg, Fickas, & Prideaux, 2011). This study demonstrated some task-novelty effects with higher task completion with TAP prompting for research-assigned experimental tasks, compared to self-selected preferred or non-preferred tasks.

The use of digital calendars on smartphones has provided a novel method of recording PM tasks and enabling the user to set alerts to deliver content-specific prompts at the appropriate times for everyday memory tasks (Ferguson, Friedland, & Woodberry, 2015; McDonald et al., 2011). Ferguson et al. demonstrated a significant increase in task completion and task punctuality when prompts were received (participants were adults aged 24 to 55 years). Furthermore, thematic analysis revealed that reminders improved participants' sense of independence, their confidence in coping

with PM difficulties, and their general mood. Research conducted by McDonald et al. with adult participants (aged 19 to 65 years) provides further evidence that digital calendar prompts provide an effective tool for compensating for PM difficulties; Google Calendar was shown to be more effective than a standard diary, and was preferred by the participants.

The use of a voice-recording device as an external memory aid has also been investigated with adult participants (aged 30 to 57 years). Van Den Broek, Downes, Johnson, Dayus, and Hilton (2000) demonstrated that all participants showed improvements on a message-passing task, and four participants showed improvements on a domestic task when they utilised voice organiser prompts.

Content-free cues and metacognitive methods. Two studies investigated the efficacy of content-free cueing and metacognitive GMT to alleviate PM task errors. Fish et al. (2007) and Krasny-Pacini et al. (2013) examined the effects of GMT and external content-free cueing (in the form of text messages) on PM task performance. Fish et al. found a significant effect of content-free cueing with adults with ABI (aged 19 to 60 years) with a greater number, and more accurate, calls on days when content-free “STOP” cues were received by participants. Krasny-Pacini et al. (2013) investigated the efficacy of an adapted version of GMT that was tailored to a paediatric population and external content free cueing (in the form of alerts reading “Look into your mental notebook”). Participants demonstrated a significant improvement on the PM task following the GMT intervention and receiving content-free cues.

Evidence for the possible remediation of prospective memory functioning. The majority of interventions included in this review surround external memory aids that were employed to prompt and consequently offer compensatory methods (either by content-specific or content-free cueing) for reducing PM failures. These studies provide evidence to suggest that various interventions can be used to compensate for

PM failures. Three of these studies, however, demonstrated a remediation of PM functioning with participants continuing to demonstrate improvements (when compared to their baseline performance) in their PM function even after their compensatory aid had been removed (Emslie et al., 2007; Wilson et al., 2005, 2009). Furthermore, Lannin et al. (2014) found that the use of a PDA device resulted in an improvement on the psychometric measure, the General Frequency of Forgetting (GFF; Gilewski, Zelinski, & Shaie, 1990) in comparison to standard rehabilitation using passive memory aids. This suggests a general subjective memory improvement separate to the PM tasks. Krasny-Pacini et al. (2013) also demonstrated that metacognitive GMT training and content-free cueing facilitated the improvement of everyday PM functioning for goals separate to the training task.

Table 1

Summary of Studies Pertaining to Content-Specific Compensatory Strategies Included in the Systematic Review

Note. Sample: cg. – Caregivers; pt. – Participants; Primary Diagnosis: ABI – Acquired Brain Injury; Enceph. – Encephalitis; TBI – Traumatic Brain Injury, Hyd – Hydrocephalus; SB – Spina Bifida; Description of Intervention: ATC – Assistive Technologies for Cognition; GMT – Goal Management Training, PDA = Personal Digital Assistant; TAP – Television Assistive Prompting; Outcomes Measures: GAS – Goal Attainment Scaling; GFF – General Frequency of Forgetting; MASS – Memory Awareness and Strategies Scale; M-CSI – Modified-Caregiver Strain Index; MFQ – Memory Functioning Questionnaire; MMQ – Memory Mistakes Questionnaire; SSUQ – Strategies of Smartphones Use Questionnaire (SSUQ); Effect sizes: (M) – Medium; (L) – Large; vs. – Versus
 All reference to study numbers in text relate to the numbers in first column of table

Study (Author/ Date / Number)	Quality Rating (%)	Study Design	Sample			Description of Study and Intervention	Outcome Measures	Effect Sizes or Main Results stated in study (if not possible to calculate ES)	Main findings
			Number of pt. / cg.	Age Range	Primary Diagnosis				
Emslie et al. (2007) Adults 1	High (77%)	Randomised- control, cross over, single-case design	4	30-49	Enceph.	Patients asked to complete PM task (such as remembering to unlock door for carer) Intervention: receiving prompts via a paging system Pts. randomly allocated to Group A (pager first) or Group B (waiting list) for seven weeks. Conditions then switched.	Completion of personal PM tasks measured for two weeks (baseline). Percentage of PM tasks successfully achieved in final two weeks of receiving pager prompts versus no prompts in comparison to baseline performance.	PM task success rates with pager ranging from 45-96% Insufficient information to calculate ES	All pt. were significantly more successful with task achievement with pager in comparison to baseline. Five weeks after returning paggers, one pt. had returned to baseline, PM task success had reduced, but not to baseline, for other pts. Overlapping sample with Wilson et al. (2005) – implications of this is considered in the discussion

Table 1

Continued

Study (Author/ Date / Number)	Quality Rating (%)	Study Design	Sample			Description of Study and Intervention	Outcome Measures	Effect Sizes or Main Results stated in study (if not possible to calculate ES)	Main findings
			Number of pt. / cg.	Age Range	Primary Diagnosis				
Ferguson et al. (2015) Adults 2	High (93%)	ABAB Single-case design:	6 pt. 5 cg.	24-55	ABI	Smartphone calendar audio-visual prompting function to deliver reminders of PM tasks (one calendar entry, two or three text messages responses, one or two voicemail responses per day, and two letters to be sent per week).	<i>Primary.</i> Number of tasks and punctuality of tasks completed when prompts were either present or absent. Phase 1- No prompting Phase 2- Prompting Phase 3- No prompting Phase 4- Prompting <i>Secondary.</i> Pre-, post-, and follow-up SSUQ, MMQ, MASS, MCSI, looking at impact of reminders on everyday memory functioning.	<i>Task completion</i> Phase 1 vs. Phase 2 $g = 0.6$ (M) Phase 2 vs. Phase 3 $g = 0.9$ (L) Phase 3 vs. Phase 4 $g = 0.8$ (L) <i>Task punctuality</i> Phase 1 vs. Phase 2 $g = 0.8$ (L) Phase 2 vs. Phase 3 $g = 1$ (L) Phase 3 vs. Phase 4 $g = 0.9$ (L)	Significant increase in task completion and task punctuality with prompts. A thematic analysis indicated that reminders improved pt. independence, confidence in coping with difficulties, and mood. Smartphone prompts may provide an effective tool for compensating with PM difficulties.
Lannin et al. (2014) Adults 3	High (93%)	Assessor-blind randomised control trial (group study)	42	17-65	ABI	Patients randomly assigned to either training or control. Training to use a PDA to set text alerts for eight weeks to compensate for PM failures. Control was standard rehabilitation, and non-electronic memory aids.	GAS that assessed success of pt. PM goals on a daily basis. Caregiver perception of memory functioning. GFF subscale of the MFQ administered at baseline and eight weeks post-intervention.	Effect size of GAS scores $g = 1.6$ (L)	Use of PDA resulted in greater achievement of memory goals and improvement on the GFF. Training in use of PDA improved pt. memory function than standard rehabilitation.

Table 1

Continued

Study (Author/ Date / Number)	Quality Rating (%)	Study Design	Sample			Description of Study and Intervention	Outcome Measures	Effect Sizes or Main Results stated in study (if not possible to calculate ES)	Main findings
			Number of pt. / cg.	Age Range	Primary Diagnosis				
Lemoncello et al. (2011) Adults 4	High (81%)	Randomised control crossover design	22	18-60	ABI	Study to ascertain task completion for two preferred, two non-preferred, and two structured tasks. Two conditions utilised TAP prompting and TYP practice (no TAP reminders).	Written list of PM tasks. Completion of tasks recorded on home logs. Participant PM task performance was compared between two conditions: when participants received TAP audio-visual, content-specific reminders at scheduled, prospective times on their home televisions and when they did not.	The results showed a significantly improved PM task performance with TAP prompting (72% PM task completion) in comparison to when they did not (43% completion). Insufficient information to calculate ES	Significant advantage of TAP prompting over no prompting. Higher task completion with TAP prompting for research-assigned experimental tasks (81%), compared to self-selected preferred (68%) or non-preferred (68%) tasks.
McDonald et al. (2011) Adults 5	High (89%)	Randomised control crossover within-subjects design	12	19-65	ABI	Pt. set tasks to target during the study. Performance compared between days Google Calendar utilised & days when paper diary was utilised. 5-week baseline, 5-week intervention phase (Google Calendar or diary). Family member rated success.	Number of identified memory targets successfully achieved using weekly monitoring form (listing individual targets and times need to be achieved) when receiving prompts from Google Calendar versus standard diary. Questionnaire developed to ascertain individual experiencing of using memory aids.	Baseline PM task accuracy: 58% Google Calendar Accuracy: 82% Standard Calendar accuracy: 55% Insufficient information to calculate ES	Google Calendar more effective than the diary in enhancing prospective memory performance. More popular with pt. Helped to prompt pt. of intentions and minimised need for external monitoring.

Table 1

Continued

Study (Author/ Date / Number)	Quality Rating (%)	Study Design	Sample			Description of Study and Intervention	Outcome Measures	Effect Sizes or Main Results stated in study (if not possible to calculate ES)	Main findings
			Number of pt. / cg.	Age Range	Primary Diagnosis				
Van Den Broek et al. (2000) Adults 6	High (81%)	Single-case series design	5	25-56	ABI	Pts. trained to use a voice Organiser (electronic memory aid) to record messages to manage PM errors.	Message-passing task: monitoring of performance on a task where pt. is required to recall message after a 9-hour delay Domestic Task: monitoring of performance on a task where pt. is required to recall household chores after one to six hour delay	Insufficient information to calculate ES	All pts. showed task improvements on message-passing task. One pt. improved on domestic task. Voice organiser may be useful in managing PM errors.
Waldron et al. (2012) Adults 7	High (77%)	Group study – A-B Quasi experimental design	5	30-57	ABI	Three week baseline (memory only). Pt. then trained to set a PDA to prompt them (audible cue and on- screen message) at appropriate times for following two weeks.	Seven personal PM tasks were set weekly to measure efficacy of PDA compared to memory alone. Task performance between Phase A and Phase B. Phase A: Memory Only Phase B: PDA intervention	Mean success in Phase A: 59% Mean success in Phase B: 90% Insufficient information to calculate ES	All achieved more PM tasks during intervention (PDA) phase in comparison to memory alone phase.

Table 1

Continued

Study (Author/ Date / Number)	Quality Rating (%)	Study Design	Sample			Description of Study and Intervention	Outcome Measures	Effect Sizes or Main Results stated in study (if not possible to calculate ES)	Main findings
			Number of pt. / cg.	Age Range	Primary Diagnosis				
Wilson et al. (2005) Adults Child and Adolescents 8	High (89%)	Randomised- control, cross over, single-case design	63	8-65	ABI	<p>Patients asked to complete PM task (such as remembering to unlock door for carer)</p> <p>Intervention: receiving prompts via a paging system</p> <p>Pts. randomly allocated to Group A (pager first) or Group B (waiting list) for seven weeks. Conditions then switched.</p>	<p>Completion of personal PM tasks measured for two weeks (baseline).</p> <p>Percentage of PM tasks successfully achieved in final two weeks of receiving pager prompts versus no prompts in comparison to baseline performance.</p>	<p>Receiving pager increased goal attainment by an average of 30% in comparison to baseline performance. Additional evidence of on-going benefits once the pager was no longer being utilised (20% more PM task completing in comparison to baseline), suggesting a possible training function.</p> <p>Insufficient information to calculate ES</p>	<p>Pt. were significantly more successful with task achievement with pager in comparison to baseline.</p>

Table 1

Continued

Study (Author/ Date / Number)	Quality Rating (%)	Study Design	Sample			Description of Study and Intervention	Outcome Measures	Effect Sizes or Main Results stated in study (if not possible to calculate ES)	Main findings
			Number of pt. / cg.	Age Range	Primary Diagnosis				
Wilson et al. (2009) Child and Adolescents to late- teenagers 9	High (78%)	Randomised control crossover trial, single case design	12	8-17	ABI	Same as Wilson et al. (2005)	Same as Wilson et al. (2005)	Receiving pages increased goal attainment by an average of 22% in comparison to baseline performance. Additional evidence of on-going benefits once the pager was no longer being utilised (11% more PM task completing in comparison to baseline), suggesting a possible training function. Insufficient information to calculate ES	All 12 participants show a significant increase in PM task achievement with use of NeuroPage Overlapping sample with Wilson et al. (2005) – implications of this is considered in the discussion

Table 2

Summary of Studies Pertaining to Content-free and Metacognitive Strategies Included in the Systematic Review

Study (Author/ Date / Number)	Quality Rating (%)	Study Design	Sample			Description of Study and Intervention	Outcome Measures	Effect Sizes or Main Results stated in study (if not possible to calculate ES)	Main findings
			Number of pt. / cg.	Age Range	Primary Diagnosis				
Fish et al. (2007) Adults 10	Moderate (64%)	Single-case series design	20	19-60	6 ABI 14 TBI	Examination of 30- minute GMT session to associate content- free cueing in the form of “STOP” text messages with reviewing task goals (PM task performance of making phone calls at set times).	Primary. Number of tasks and punctuality of tasks completed on days when content-free cues (“STOP” texts) were and were not received.	$g = 0.5$ medium effect for accuracy of making phone calls (cued vs un-cued days; un-cued days as control)	Significant effect of content- free cueing with greater number of PM tasks completed (more calls made) and greater accuracy of call times.

Table 2

Continued

Study (Author/ Date)	Quality Rating (%)	Study Design	Sample			Description of Study and Intervention	Outcome Measures	Effect Sizes or Main Results stated in study (if not possible to calculate ES)	Main findings
			Number of pt. / cg.	Age Range	Primary Diagnosis				
Krasny- Pacini et al. (2013) Child and Adolescents 11	High (89%)	Single-case series design	3	8-14	ABI	Pt. completed GMT training, aimed to improve meta- cognitive strategies to self-monitor personal goals. This training comprised of 15 modules, completed over 15-20 hours over a four- to six-month period on a weekly basis.	Pts. were asked to complete a PM task (where three times per week they had to look up the day's Saint on a calendar and send this information to the researcher by text, phone call or email). Pts. received content-free prompt ("look into your mental notebook") if PM task omitted. Effectiveness of the GMT training was monitored through a weekly score on this time-based PM task. GAS for real-life goals were employed to assess whether child applied metacognitive strategies to meaningful activities. GAS goals not trained specifically, but children encouraged to employ metacognitive strategies to everyday life.	PM task: Pt. 1: 0.5 (M) Pt.2: 0.7 (M) Pt 3: 0.9 (L) GAS: Improvement in GAS scores (T-scores) for everyday goals (pre-post comparison) for all pt. Insufficient data to calculate effect sizes.	Pts. demonstrated a significant improvement on the PM task following the GMT intervention. GMT facilitated the improvement of everyday PM functioning without direct training, suggesting generalisability of metacognitive training to untrained tasks.

Note. Sample: cg. – Caregivers; pt. – Participants; Primary Diagnosis: ABI – Acquired Brain Injury; TBI – Traumatic Brain Injury; Description of Intervention: GMT – Goal Management Training; Outcomes Measures: GAS – Goal Attainment Scaling; Effect sizes: (M) – Medium; (L) – Large; vs. – Versus. All reference to study numbers in text relate to the numbers in first column of table

Discussion

The studies outlined in this systematic review demonstrate that a number of varying rehabilitation methods are available to alleviate PM deficits following ABI. These include compensatory strategies in the form of external memory aids, which provide either content-specific or content-free cueing, and training programmes aimed at facilitating meta-cognitive skills (e.g., self-monitoring and self-evaluating personal goals). This review has also highlighted that there is a greater availability of research pertaining to adult rehabilitation and only two studies involving paediatric participants. This limited evidence-base for paediatric rehabilitation has also been highlighted in previously published reviews (Fish et al., 2010; Laatsch et al., 2007; Limond & Leeke, 2005; Ross et al., 2011). Overall, research in the field of PM interventions following ABI is, however, arguably limited relative to other disorders.

Critique of research included in the review. 10 of the 11 studies achieved a high quality rating and one received a moderate quality rating, according to the appraisal criteria utilised in the review (see Figure 2). This suggests that the risk of bias in individual studies and across studies was low, and the eligible records in the review were largely valid. They were deemed to have appropriate research methods, an adequate description of the intervention, and employed appropriate statistical analysis, for example.

Although all literature included in this review demonstrated promising findings in favour of a variety of PM interventions, it was only possible to report the ES for four of the studies included in the review (studies 2, 3, 10, and 11). It was not possible to calculate the ES for the remaining studies, because the means and standard deviations were not reported. Consequently, for seven of the studies (studies 1, 4, 5, 6, 7, 8, and 9), it is only possible to state that the interventions resulted in a significant improvement in PM performance, and not the magnitude of the effect of the intervention. Although

this does not mean that a large effect size for the intervention was not present in these studies, it is not possible to reliably state this.

Five of the studies (studies 3, 4, 5, 6, and 7) included in the review did not examine the effects of removing the content-specific strategies on PM task performance. It is, therefore, possible that the improved PM performance reflect the cumulative effect of the ongoing, novel intervention rather than the specific strategy (e.g., pager, PDA) itself. An alternative research design, therefore, may have been to employ an A-B-A-B approach. Future studies, however, would need to carefully consider the ethical dilemma of withdrawing a compensatory strategy that is proving helpful to participants.

A further limitation of seven of the studies (studies 2, 3, 4, 6, 7, 8 and 10) employed in this review is that they did not compare contrasting compensatory external memory strategies for PM task performance. Consequently, knowledge surrounding the *superiority* of one strategy over another is limited which, therefore, limits the evidence-base regarding the efficacy of a certain compensatory strategy for a certain presentation or age group. Each of the studies included in this review employed different outcome measures, which further limits comparison between the efficacy of contrasting external memory strategies. Future research could focus on comparing multiple compensatory strategies using the same, standardised PM outcome measures.

Critique of review. Although Fish et al. (2010) conducted a review looking at the assessment and rehabilitation of PM deficits in people with neurological disorders, to the author's knowledge, this is the first systematic review looking solely at PM interventions following ABI. This review, therefore, offers a unique opportunity to consider the theoretical and clinical implications of the available literature for this patient group.

A further advantage of this review is that both single-case and group studies

were included. It has, however, been argued that single-case studies are less valid than group studies due to external validity limitations (Cicerone, Azulay, & Trott, 2009). Tate et al. (2008), conversely, report that single-case methods are readily applicable to clinical practice, in addition to providing a unique method of documenting individualised outcomes and thus providing empirical evidence in support of rehabilitation approaches. Nonetheless, a possible direction for future research could be to conduct randomised control trials using interventions that have proof-of-principle (based on findings from single-case designs) to further explore the effectiveness of the interventions and establish the generalisability to large sample sizes.

A limitation of the current review is that 16 records were excluded due to inadequate description of rehabilitation programmes. It was, therefore, not possible to critique the efficacy of these programmes for rehabilitating PM functioning.

Three of the studies (studies 1, 8, and 9) included in this systematic review contained overlapping samples. They cannot, therefore, be considered as three independent studies when evaluating the strengths and limitations of the evidence and drawing conclusions across the literature.

Implications for clinical practice. This review has highlighted a variety of contrasting methods of rehabilitating PM deficits; however, clinicians should remain mindful that eight of the 11 studies included in the review investigated the efficacy of PM interventions with adult participants only. Given the limited availability of research evidence to support the efficacy of PM interventions in a paediatric population, it is imperative that future research focuses on contributing to this evidence-base. Although very few studies exist for the paediatric population, it could be argued that all of the interventions shown to be effective in adults could be adapted for a paediatric population, providing that the age and developmental level of the child is considered when designing the intervention (Limond, Adlam, & Cormack, 2014). Wilson et al.

(2009) successfully utilised a paging system in both adults and children, and demonstrated PM improvements. Krasny-Pacini et al. (2013) demonstrated the efficacy of a memory rehabilitation programme and content-free cueing for improving PM deficits in children with ABI, which utilised an adapted GMT intervention previously employed with adults (Fish et al., 2007). This suggests that interventions utilised with adults can be effective; however important adaptations may be necessary, as evidenced by Krasny-Pacini et al. (2013). Paediatric rehabilitation needs to consider cognitive function in the context of on-going maturation (rather than the loss of function, as is often the case in adult interventions).

Limond et al. (2014) suggest a sequential approach to intervention and they state that lower-level cognitive processes “must be optimised to facilitate rehabilitation of higher-order specific processes” (p. 183). They have proposed a theoretical model to help guide paediatric interventions, which consider the cognitive maturation of the child/adolescent. The model proposes a hierarchy for different rehabilitation approaches dependent upon the cognitive capabilities necessary for the intervention to be effective. Clinicians must, therefore, be mindful of this model when adapting interventions from an adult population.

Implications for theory and research. A number of studies in this review have shown evidence of the strategies having transfer effects; Wilson et al. (2005, 2009) and Emslie et al. (2007) found that, even after a pager system was removed, participants continued to achieve more of their PM tasks in comparison to their baseline performance; Krasny-Pacini et al. (2013) also demonstrated that a hybrid approach of metacognitive GMT training and content-free cueing can facilitate the improvement of everyday PM functioning for goals separate to the training, and; Lannin et al. (2014) found that participants reported a general subjective memory improvement separate to the PM tasks. These findings, therefore, raise an interesting theoretical question: can

external memory strategies designed to compensate for PM deficits facilitate the remediation of PM functioning? Unfortunately, these findings were not discussed in detail within these papers. It is, therefore, unclear if the participant internalised a memory strategy to support PM, developed a habit or routine and thus minimised the PM demands, or developed PM skills, as a result of the repeated use of an external memory aid. Although it may not be possible to definitively answer these queries within this review, the findings are, nonetheless, interesting towards the debate of whether PM is a skill that can be taught or whether it can only be facilitated through external strategies. Regardless, this review highlights that external strategies aimed to improve PM task performance can be generalised to facilitate everyday PM functioning for participants.

Conclusions. This review has summarised and critiqued the findings of studies that investigate the efficacy of PM interventions in individuals with ABI. The literature demonstrated the efficacy of varying rehabilitation methods to alleviate PM deficits following ABI; significantly greater PM tasks were completed when participants received either content-free or content-specific cues or took part in a metacognitive training programme. This suggests that PM abilities can be improved following ABI by utilising simple reminder systems. The review has also highlighted that interventions utilised with adults can be effective; however, paediatric rehabilitation might benefit from considering the influence of on-going cognitive maturation when contemplating which adult interventions might be effective with children. Limond et al.'s (2014) theoretical model might provide a useful framework to guide future research in this area. The review has also highlighted that external strategies aimed to facilitate PM task performance can be generalised to facilitate everyday PM functioning. A major finding of this review is that there is an extreme lack of research of PM interventions conducted in children with ABI, and future research is needed to

improve this evidence base. Future PM interventions for children may choose to target content-free cueing and metacognitive training, given the evidence suggesting that this approach has potentially more *generalisable promise* due to the content-free intervention not being limited to specific activities.

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**SCHOOL OF PSYCHOLOGY
DOCTORATE IN CLINICAL PSYCHOLOGY**

EMPIRICAL PAPER

**Content-Free Cueing and ‘Remembering Goals’ Training: The Rehabilitation of Prospective
Memory Deficits in a Paediatric Population**

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Abstract

Background: It is often considered that, following paediatric acquired brain injury (pABI) and epilepsy, higher-level cognitive deficits, such as prospective memory (PM), are impaired and may only become apparent over time when these abilities are expected to develop and mature in a typically developing child. Interventions supporting PM have the potential to increase independence and enhance social participation. Despite research indicating PM difficulties in children and adolescents with pABI and epilepsy, and also in children with PM difficulties with unknown aetiology, currently, there is a limited evidence-base for interventions, although previous research has attempted to address this following pABI (Rous, 2011).

Objective: The objective of this empirical paper was to build upon the work of Rous (2011) and optimise the effectiveness of brief metacognitive ‘Remembering Goals’ Training (RGT) and external content-free cueing (in the form of “STOP” text messages) on PM task performance and the achievement of real-life goals.

Method: The research employed a single-case series design with a randomised, alternating treatment (Barlow & Hayes, 1979). Eight participants (aged 10-15 years) completed the study. Three participants had an ABI, two participants had epilepsy, and three participants experienced PM difficulties with unknown aetiology. The PM task required participants to send three text messages at set times and to complete three real-life goals each working day for a four-week period. After a baseline period, participants completed brief RGT via Skype twice during the study (once following baseline, and again half way through the study). The brief RGT facilitated metacognitive skills and participants learnt to associate texts reading “STOP” with

mentally reviewing their goals and tasks for that day. Six “STOP” text messages (cues) were sent at random times on half of the days of the intervention. The number and accuracy of texts messages, and the achievement of real-life goals, were compared across cued and un-cued days to evaluate the efficacy of the intervention for each participant.

Results: Five participants demonstrated improved PM text message performance and seven participants demonstrated improved performance in real-life goals. Most of the participants reported positive gains in self-reported PM abilities, and most parents of children with acquired neurological conditions reported reduced levels of family stress and burden following the intervention.

Conclusions: This research offers some evidence in support of the efficacy of content-free cueing and RGT for facilitating PM abilities. The majority of participants engaged in more frequent and accurate PM tasks and, most importantly, achieved more of their real-life goals as a result of the intervention.

Keywords: *Prospective Memory, Acquired Brain Injury, Epilepsy, Children, Adolescents, Rehabilitation, Intervention*

Introduction

Prospective Memory

“I’ll do it later”; “I can’t do that now”; “I must remember to do that when I get a chance” - There are often moments when individuals cannot carry out a goal immediately. Instead, they rely on an ability to remember the goal that they have set and to retain the goal for a particular moment or setting when it needs to be executed (Fish, Wilson, & Manly, 2010). To successfully complete goals, such as passing on a message to a friend or attending an appointment, one must utilise one’s executive function (EF). EF refers to the integration of cognitive processes that support goal-directed, purposeful behaviour that is vital for the execution of many daily living tasks (McCauley & Levin, 2004). This includes the ability to anticipate the consequences of actions, the ability to formulate plans, and the ability to monitor, adapt and organise behaviour depending upon the task or context (Burgess, Scott, & Frith, 2003; Duncan, Emslie, Williams, Johnson, & Freer, 1996; Ellis & Freeman, 2008).

Prospective memory (PM) is the outcome of a series of cognitive processes, primarily memory and EF, rather than a distinct neural construct (Fish et al., 2010; Rous, 2011; Simons, Schölvink, Gilbert, Frith, & Burgess, 2006). It refers to the ability to remember to carry out a planned action in the future (Ellis, 1996); this can refer to an event-based action (e.g., purchasing an item when you see a certain shop), a time-based action (e.g., remembering an appointment), or an activity-based action (e.g., turning off the oven after you have cooked dinner; Kvavilashvili and Ellis, 1996). McDaniel and Einstein (1992) have separated event-based PM into two components; cue identification, which involves the recognition of cues for the event (for example, seeing the shop), and; intention retrieval, which involves the retrieval of information for the event (for example, purchasing the item) from memory (Simons et al., 2006).

To successfully engage in a PM task, it is theorised that one must initially encode and remember the action required. Individuals with dense amnesia will naturally exhibit impairments in their PM abilities as a consequence of overarching profound memory failure. A degree of intact memory functioning is, therefore, a prerequisite to successfully completing PM tasks. Secondly, an individual is required to recall the action at the necessary time, which involves a dependence on cognitive abilities such as attention and intact executive systems (specifically, systems surrounding goal-directed behaviour, such as the ability to plan and organise). One must then execute the action, and finally utilise metacognitive skills to evaluate the outcome of the action so as to avoid unnecessary repetition of the PM task (Fish et al., 2007). The theoretical process of engaging in a PM task is illustrated in Figure 1 below.

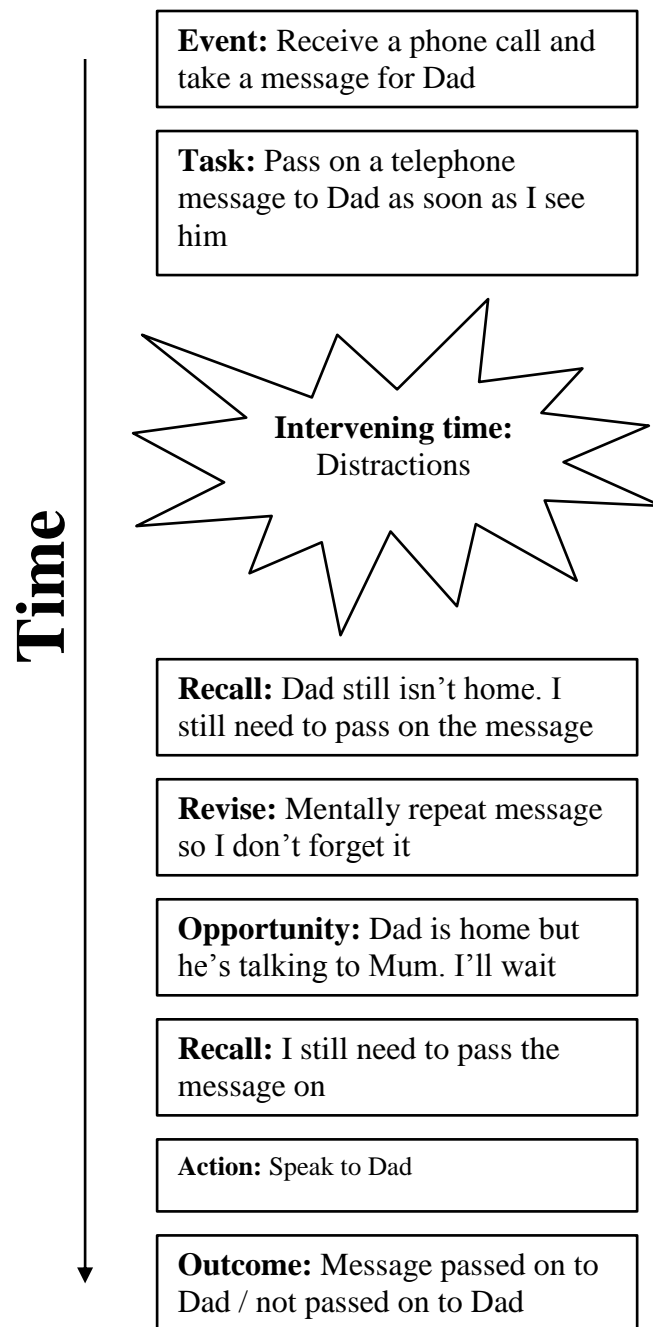


Figure 1. The theoretical process of engaging in a prospective memory task (Fish et al., 2007; Fish et al., 2010).

The Development of Prospective Memory in Children and Adolescents

The frontal cortex is widely considered to be the neural region largely responsible for cognitive processes relating to EF, including PM (Burgess, Quayle, & Frith, 2001; Burgess et al., 2008; Simons et al., 2006). This is supported by neuroimaging studies (Simons et al., 2006; Burgess et al., 2008) and clinical case studies of individuals with lesions within the frontal lobes (Rendell, Jensen, & Henry, 2007; Shallice & Burgess, 1991). Accordingly, literature suggests that the development of PM in children and adolescents occurs in line with the protracted maturation of the frontal lobes throughout childhood, adolescence and into early adulthood (Gogtay et al., 2004; Romine & Reynolds, 2010; Sowell, Delis, Stiles, & Jernigan, 2001). Furthermore, research is available to suggest that there is a developmental improvement in PM abilities (Einstein, McDaniel, Marsh, & West, 2008). Evidence suggests that PM abilities normally develop between the ages of 7- to 12-years old (Kerns & Price, 2001; Marlowe, 2000), and continues to improve throughout adolescence (Shum, Cross, Ford, & Ownsworth, 2008; Ward, Shum, McKinlay, Baker-Tweeney, & Wallace, 2005) and into early adulthood (Wang, Kliegel, Yang, & Liu, 2006).

Impairments in Prospective Memory Function in Children and Adolescents

The experience of PM difficulties is arguably a common occurrence, not only in typically developing children and adolescents, but also in adulthood (Baddeley, 1997). Baddeley argued that when individuals state that they have a *poor memory*, they are likely to be referring to experiencing PM difficulties. Kinsella et al. (1996) further support this assertion with evidence that subjective memory problems on self-rating scales have a greater correlation with poorer PM performance than retrospective memory performance in both individuals with acquired brain injury (ABI) and typically developing, neurologically 'healthy' population.

For many individuals who experience PM difficulties, the failure to carry out a planned goal is rarely due to an inability to remember the goal (such as with those with dense amnesia). Instead, PM omissions are more likely to occur if the individual is unable to satisfactorily utilise metacognitive abilities, such as their ability to recall, review, and execute the goal (Fish et al., 2010). Given its higher order cognitive function, metacognitive abilities are considered to be the outcome of a series of cognitive processes. Accordingly, PM abilities can be disrupted if any of the neural regions associated with these cognitive processes are damaged, which is thought to account for the frequency with which impairments in PM abilities are reported in individuals with neurological conditions such as ABI and epilepsy (Fish et al., 2010; Hermann & Seidenberg, 2008).

An ABI is a non-degenerative injury to the brain after birth that is not the result of a congenital or a developmental disorder (Appleton, 1998). ABI can be the consequence of external or internal insults. For example, external insults, also known as a traumatic brain injury (TBI), can be a consequence of a fall, a motor vehicle accident, or an assault; internal insults can be a consequence of infection (such as encephalitis or meningitis), a cerebral vascular accident (more commonly known as a 'stroke'), or a brain tumour (Bodack, 2010). Epilepsy is a neurological condition characterised by abnormal electrical activity in the brain (Hermann & Seidenberg, 2008). This results in seizures and a transient loss of consciousness. Prolonged seizure activity can cause damage to the neural focus of the seizure, in addition to damage to the surrounding neural regions. Prolonged seizure activity can, furthermore, be the consequence of neural damage (Gazzaniga, Ivry, & Mangun, 2009).

It is generally accepted that the experience of paediatric ABI (pABI) and epilepsy have the potential to damage neural regions leading to multiple cognitive difficulties including PM deficits (Hermann & Seidenberg, 2008; Ross, Dorris, &

McMillan, 2011). Children who experience impairments in PM often rely upon their family for support with even simple tasks; this can impact on their independence, and often increases stress and burden within the home environment (Krasny-Pacini, Chevignard, & Evans, 2014).

The Rehabilitation of Prospective Memory in a Paediatric Population

It is often considered that, following pABI and epilepsy, higher-level cognitive deficits, such as PM, may only become apparent over time when these abilities are expected to develop and mature in a typically developing child. Rehabilitation for children thus needs to consider the developmental and maturational context for each individual child. For example, Limond, Adlam, and Cormack (2014) proposed a model to help guide paediatric neurocognitive interventions taking into account cognitive maturation. The model proposes a hierarchy for different rehabilitation approaches dependent upon the cognitive capabilities necessary for the intervention to be effective (see Figure 2). According to this model, to benefit from an intervention at a certain level, an individual must have developmentally appropriate (or at least sufficient) cognitive abilities at all lower levels of the model. For example, it is theorised that for individuals to benefit from interventions at 'Level C' (e.g., evaluative, metacognitive skills), they must have sufficient 'Level A' (e.g., semantic knowledge about the world) and 'Level B' (e.g., processing speed, working memory, attention) cognitive abilities. In the context of this model, PM is considered to be a 'Level C' cognitive evaluation skill as it requires self-monitoring.

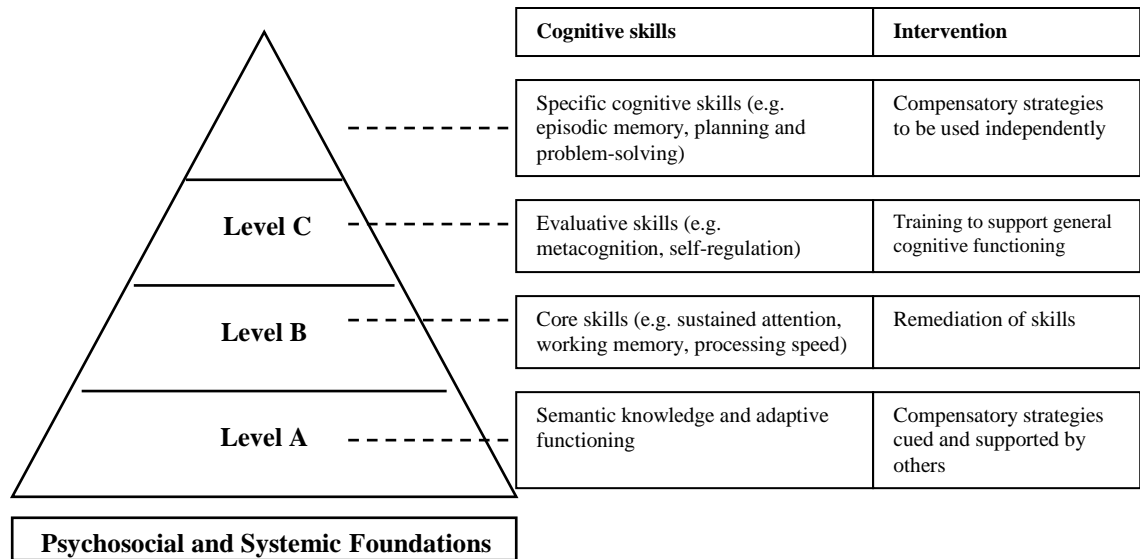


Figure 2. Limond et al. (2014) theoretical model of paediatric neurocognitive interventions.

Despite research indicating PM difficulties in children and adolescents with pABI and epilepsy, currently, there is a limited evidence-base for interventions (Laatsch et al., 2007; Limond & Leeke, 2005; Ross et al., 2011). Rous (2011) investigated the efficacy of an intervention for PM deficits following pABI. Rous adapted a rehabilitation strategy utilised by Fish et al. (2007), which yielded positive effects for adults with PM deficits. Fish et al. examined the effects of brief Goal Management Training (GMT) and external content-free cueing (in the form of text messages) on PM task performance. GMT is an intervention that has been developed to facilitate self-regulation of goals in individuals experiencing EF and memory difficulties (Duncan, 1986). It promotes a metacognitive approach to engaging in daily activities by increasing one’s awareness of *memory mistakes* and lapses in attention. It comprises self-monitoring and cognitive techniques to facilitate planning, PM, and cognitive control (Krasny-Pacini et al., 2014; Levine et al., 2011).

Rous piloted the intervention with seven adolescents (aged 12-17 years) with

self-reported PM difficulties following pABI, and gathered feedback on their experience and acceptability of the intervention (Rous, 2011).

Participants were asked to make three phone calls a day to a voicemail service at set times, for a three-week period. The total number of calls made and accuracy of call times were recorded to yield a measure of PM. Following a one-week baseline period, participants were given brief GMT (a one-hour individual session) to associate receiving text messages reading “STOP” to cue them to mentally review their goals of making the phone calls (“Stop, Think, Organise, Plan”). Over the next two-weeks participants were sent six “STOP” text alerts on five of the ten working days. For each individual, task performance was compared between cued and un-cued days (Rous, 2011).

Rous (2011) found that, for four out of seven participants, PM performance was superior on days where participants received text message cues, in terms of a significantly greater number of calls, in addition to more accurate timings of calls. Although this study suggests that the intervention shows promise for reducing PM difficulties following pABI, not all children benefited from the intervention. In discussion of this and in critique of the research, Rous suggested that the baseline period may not have been long enough to adequately reduce the confounding effects of task novelty for two participants, and thus they were potentially unable to benefit from the intervention. Furthermore, inclusion in the study was based solely on qualitative reports of participants’ PM difficulties (e.g. parent, self, clinician reports). Without a standardised measure of PM, it is possible that the participants who did not benefit from the intervention may not have been experiencing PM deficits; however, this remains uncertain. Some participants also reported finding the task ‘boring’, which may also have impacted upon their engagement with the research.

To the authors' knowledge, no studies, specifically targeting and evaluating the rehabilitation of PM deficits, have been conducted with children with epilepsy, despite reported PM difficulties. Furthermore, although children can experience PM difficulties without any known neurological cause (e.g., in a similar way to children experiencing poor working memory with unknown aetiology; Holmes & Gathercole, 2014), to date, no studies have investigated whether these individuals can benefit from PM interventions.

Rationale and Aim of Current Study

To date, no research has attempted to address the limitations of Rous (2011) study. In addition to adapting the design of the research to address the limitations of Rous' study, it would also be interesting to investigate if this intervention could be utilised to facilitate the achievement of 'real-life goals'. This is considered the clinical purpose of rehabilitation (Wilson, Gracey, Evans, & Bateman, 2009) and was not explored by Rous. The current study aims to further develop the intervention for use with children and adolescents aged 10-18 years; whereas Rous only recruited participants aged 12-17 years. The rationale for this extension is that, as explored previously, individuals typically develop PM before the age of 12; consequently, it would be interesting to explore if individuals younger than 12 can benefit from the intervention.

The primary aim of the study is to replicate and extend Rous' study and thus recruit children with pABI. It was decided a priori, however, that if recruitment difficulties occurred, then recruitment would be extended to include other adolescents who experience PM deficits, such as those with epilepsy and children experiencing PM difficulties with unknown aetiology (i.e., that the child had not received a diagnosis of a neurological disorder or condition from a neurologist or other health specialist). The rationale for this was to establish if children and adolescents with PM deficits can

benefit from the intervention, regardless of the aetiology or diagnosis for their difficulties. Furthermore, these two groups were considered relevant to the aims of the study due to the current lack of research focusing on treatments for PM difficulties in children and adolescents, including those with epilepsy.

The intervention used in the current research is ‘Remembering Goals’ Training (RGT), which was adapted from GMT. The main aim of the current research was to build on previous studies, and optimise the effectiveness of brief RGT and external content-free cueing on PM task performance and achievement of real-life goals.

Research Questions

1. Does brief RGT and content-free cueing (“STOP” text message) improve the execution of a PM task in children and adolescents (aged 10 to 18 years) with PM difficulties?
2. Does brief RGT and content-free cueing (“STOP” text message) facilitate the achievement of real-life goals in adolescents (aged 10 to 18 years) with PM difficulties?

Research Hypotheses

1. Participants will show significantly better performance on the PM task on days when they receive “STOP” cues in comparison to days without cues; better performance will be predicted in both the number of PM tasks completed and the accuracy of PM task timings.
2. Participants will achieve more of their real-life goals on days when they receive “STOP” cues in comparison to days without cues.

Method

Design

The research employed a single-case series design with a randomised, alternating treatment (Barlow & Hayes, 1979). This permitted the exploration of the effects of the intervention (RGT and ‘content-free cueing’) on PM performance by comparing PM task performance and real-life goal attainment on days that participants received external content-free cues to days without cues. Single-case methods are often utilised in the evaluation of neuropsychological interventions (Crawford & Garthwaite, 2012). Furthermore, Tate et al. (2008) report that single-case methods are readily applicable to clinical practice, in addition to providing a unique method of documenting individualised outcomes, and thus provide empirical evidence in support of rehabilitation approaches. Given the nature of a repeated single-case series design that the study employed, the impact of individual factors on outcome were accounted for within each participant (the impact of individual differences on the outcome variable was ‘controlled’ for within the design).

Participants

It is widely accepted that new rehabilitation approaches “should first be examined with a small number of individuals to test the therapeutic effect” (Beeson & Robey, 2006, p. 162). Furthermore, valid conclusions regarding the effectiveness of an intervention for each participant are permitted in single-case designs (Dugard, File, & Todman, 2012). Consequently, a power analysis or a large number of participants were not required for this study.

As detailed in the rationale of the study (page 57), the initial aim of the study was to employ opportunity sampling to recruit approximately 10 participants between ages 10-18 years with a pABI, who experienced PM difficulties. Due to significant recruitment difficulties (described in detail in Appendix A), the inclusion criteria for the

study were extended to include children with epilepsy and PM difficulties, and children with poor PM of unknown aetiology.

Inclusion and exclusion criteria. Inclusion criteria for the study were:

- Participants must experience PM difficulties, as determined by at least one of the two following measures: a score of 22 or greater on the prospective scale of the Participant and/or Carer Prospective and Retrospective Memory Questionnaire (PRMQ; Smith, Della Sala, Logie, & Maylor, 2000) and/or a scaled score in the “impaired range” on the Six Part Test from the Behavioural Assessment of the Dysexecutive Syndrome for Children (BADS-C; Emslie, Wilson, Burden, Nimmo-Smith, & Wilson (2003). This inclusion criteria was to ensure that those participating in the research were experiencing everyday PM difficulties that were measurable to a clinical level. If participants performed well on the BADS-C, their scores on the PRMQ would have to be 22 or greater to be included in the study.
- Participants with pABI must be medically and cognitively stable prior to recruitment; they must be at least six-months post-injury to allow for optimal neural recovery (Anderson, Catroppa, Morse, Haritou, & Rosenfeld, 2005).
- Participants with epilepsy must be seizure free for at least six-months prior to recruitment to prevent seizure activity impacting upon participants’ engagement in the PM task.
- Participants must be able to speak and read basic-level English.
- Participants must be able to use a mobile phone to be able to engage in the PM task by sending texts messages.

Exclusion criteria for the study were:

- Participants must not have pre-morbid experience of any of the conditions listed

below. The rationale for this exclusion criterion was to optimise treatment gains and to prevent the potential confounds of pre-morbid difficulties:

- A diagnosis of developmental delay
 - A learning disability
 - An attention disorder
 - A mental health difficulty that may impact on cognitive abilities (e.g. depression; Austin, Mitchell, & Goodwin, 2001).
- Participants must not experience sensory-perceptual-motor deficits that may inhibit their ability to use a mobile telephone.
 - Participants must not have dense amnesia or poor long-term memory that might hinder their engagement in the PM task, as determined by a detailed neuropsychological test battery during background assessment.
 - In accordance with the Limond et al. (2014) model of paediatric neurocognitive interventions, the intervention in the current study supports metacognition; a 'Level C' ability. Participants who were significantly impaired on 'Level A' (e.g., semantic knowledge) and 'Level B' (e.g., working memory) cognitive abilities were, therefore, excluded from participation. This was determined by a detailed neuropsychological test battery during background assessment; with the exception of scores on the BADS-C, all Standard Scores (SS) on the neuropsychological test battery must be four or above.

Sample characteristics. Eight children and adolescents (six males and two females; aged between 10 and 15 years old; mean age = 11.9; SD = 1.8; SEM = .64) completed the study. Table 1 provides more detailed sample characteristics about each participant. Appendix B illustrates the recruitment process for this study in a flow diagram.

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Table 1

Summary of Participants Demographic Characteristics and Nature of Injury/Diagnosis

Participant	One	Two	Three	Four	Five	Six	Seven	Eight
Gender	Male	Male	Male	Male	Female	Male	Female	Male
Age at testing	10 years 1 month	15 years 10 months	14 years 8 months	12 years 1 month	10 years 9 months	12 years 11 months	11 years 10 months	11 years 2 months
Age at injury/diagnosis	3 years	4 years	11 years	-	-	10 years	-	-
Time since injury/diagnosis	7 years	-	3 years	-	-	2 years	-	-
Primary Diagnosis	ABI (encephalitis)	Idiopathic generalised epilepsy	TBI (RTA)	Under investigation for epilepsy	Aetiology of PM difficulties unknown	TBI (RTA)	Aetiology of PM difficulties unknown	Aetiology of PM difficulties unknown
Site of injury (if known)	-	Frontal lobe focus	Right temporal and basal skull fracture. Right craniotomy and evacuation of extradural haematomas.	-	-	Frontal diffuse axonal injury. Bilateral traumatic subarachnoid haemorrhage.	-	-
Additional difficulties?	-	Fatigue	Fatigue. Chronic headaches	-	-	Fatigue	-	-
Social circumstance	Living at home with parents	Living at home with parents	Living at home with parents	Living at home with parents	Living at home with parents	Living at home with parents	Living at home with parents	Living at home with parents
Schooling	State Primary School	Private Secondary School	Medical Tuition	State Secondary School	State Primary School	State Secondary School	State Secondary School	State Secondary School

Table 1

Continued

Participant	One	Two	Three	Four	Five	Six	Seven	Eight
Additional rehabilitation?	None	None	None	None	None	Yes – but not for PM difficulties	None	None
Source of recruitment	UoE CCNR webpage	BRHC	BRHC	CoRaL Ltd	UoE CCNR webpage	CoRaL Ltd	UoE CCNR webpage	UoE CCNR webpage

Note. ABI = Acquired Brain Injury; BRHC = Bristol Royal Hospital for Children; CoRaL Ltd = Cognitive Rehabilitation and Learning for Children and Young Adults Psychology Ltd; RTA = Road Traffic Accident; TBI = Traumatic Brain Injury; UoE CCNR = University of Exeter’s Centre for Clinical Neuropsychology Research (CCNR) webpage advertising for participants.

Ethical Considerations for Empirical Research

The study was given a favourable opinion by the University of Exeter Ethics Committee and the NHS South West – Bristol Research Ethics Committee (see Appendix C for Ethical Approval letter and email). Ethical issues surrounding the participation of children and adolescents in research were considered in line with Medical Research Council (MRC, 2004) and British Psychological Society (BPS) guidance (BPS, 2004). A detailed risk protocol, which outlines all the ethical considerations for this empirical research, is provided in Appendix D.

Apparatus and Materials

Background assessment. During the initial meeting, all participants and their parents completed a clinical interview to permit the gathering of information surrounding the participant, including: participant's age; their experience of PM difficulties; the nature of their injury (if applicable); their daily routine; their support, and; their current use of memory strategies. Appendix E contains the clinical interview proforma used to guide these interviews.

Characterisation Measures. To characterise participants' cognitive abilities, a full neuropsychological assessment battery was conducted prior to the experiment (see Table 2). The neuropsychological assessments were selected in line with Rous (2011) based on models of executive function (e.g., Supervisory Attention System; Norman & Shallice, 1986) and PM (e.g., Multi-Process Model; Einstein & McDaniel, 1986). This permitted the assessment of general intellectual function (including processing speed, visuo-spatial construction, working memory, and verbal comprehension), verbal memory, sustained attention and vigilance, and executive function. The measures were employed to characterise participants' cognitive profile only, and were not repeated to evaluate the intervention. If any participant had completed any of the measures before being recruited to the study (within the previous year), permission was sought to use

these scores to characterise participants' cognitive profiles instead of repeating the measures. This prevented practice effects impacting upon test performance. Details surrounding the psychometric properties of these measures are available in Appendix F.

Table 2

Summary of the Neuropsychological Assessment Battery

Neuropsychological Assessment	Author(s)	Cognitive ability being assessed
Symbol Search, Digit-symbol coding, Digit Span, Matrix Reasoning, Block Design, Vocabulary, and Similarities subtests from Wechsler Intelligence Scale for Children Fourth Edition (WISC-IV UK)	Wechsler (2003)	General neuropsychological abilities (including processing speed, working memory, visual-spatial reasoning, and verbal comprehension)
Stories subtest from the Children's Memory Scale (CMS)	Cohen (1997)	Immediate and delayed verbal memory
D-KEFS Trail Making Tests (Condition 2: Number Sequencing; Condition 3: Letter Sequencing; Condition 4: Letter-Number Switching)	Delis, Kaplan, & Kramer (2001)	Processing Speed, Response Inhibition and Cognitive Flexibility
Walk, Don't Walk subtest from the Test of Everyday Attention for Children (TEA-Ch)	Manly, Robertson, Anderson, & Nimmo-Smith (1999)	Sustained attention and response inhibition
Six Part Test from the Behavioural Assessment of the Dysexecutive Syndrome for Children (BADS-C)	Emslie et al. (2003)	Planning and goal maintenance (components of PM). Groot, Wilson, Evans & Watson (2002) have demonstrated a correlation between planning and goal maintenance and performance on the six part test.
Family Burden of Injury Interview (FBII)	Burgess et al. (1999)	A measure of the burden of impairments on families
Self and informant versions of the PRMQ	Smith, Della Sala, Logie, & Maylor (2000)	Evaluation of participants' efficiency of PM in everyday life

User consultation

A limitation of Rous (2011) was that some of the participants reported that the PM task of making phone calls was somewhat laborious, which potentially hindered their level of engagement and consequently may have confounded the results. Consequently, four-local school children were consulted in a focus group in Spring 2014 to establish the type of PM task that was adolescent friendly and one that participants would most likely engage with. The University of Exeter Psychology Ethics Committee granted full ethical approval for this focus group. Following this group, the 'PM task' for the current research was to ask participants to send three text messages at set times.

Outcome Measures

The primary outcome measures were the performance on the text message task (see below) and the total number of goals successfully achieved. The secondary outcome measures were the exploratory analysis of scores between pre- and post-intervention on the PRMQ and the Family Burden of Injury Interview (FBII; Burgess et al., 1999). Furthermore, participants were asked to provide feedback about their subjective experience of the intervention.

Text-messaging task. Participants were asked to send three text messages per working day to the researcher, for a maximum of 24-working days (six- to 12-working days for baseline; 12-working days for the intervention). In line with Rous (2011), to examine Hypothesis 1, two methods of scoring the text-messaging task were employed; the proportionate score and the composite score. The Proportionate Score yielded the number of text messages sent each working day (maximum three). For the duration of the intervention, the maximum number of texts each participant could send was 36 (18 on total cued-days and 18 on total un-cued days). The Composite Score was employed to assess accuracy of PM task performance using a six-point scale (consistent with

Rous, 2011): six points were awarded to the participant for each text if the text was sent within 10 minutes of the scheduled target time; five points were awarded if the text was sent within 20-minutes; four points if the text was sent within 30-minutes; three points if the text was sent within 40-minutes, two points if the text was sent within 50-minutes; one point if the text was sent within one hour of the target time, and; no points were awarded if the text was sent more than an hour late. For the duration of the intervention, the maximum composite score was 216 (108 on cued days and 108 on un-cued days).

Real-life goal task. Participants were asked to set three ‘real-life goals’ for each day of the study, for example, remembering to feed a pet at a specified time. These were determined entirely by the participant and involved PM goals that they typically struggled with. Participants and their parents were asked to rate how successful they thought they were in remembering their own goals at the end of each day (0 = not achieved; 1 = partially achieved; 2 = completed). A maximum score of six was yielded if all three goals are achieved. Use of goals attainment scales were considered; this simple method of goal rating was preferred, however, due to the frequency with which participants had to set goals and to facilitate engagement with the study. For the duration of the intervention, a maximum score of 72 could be achieved for the real-life goal task (36 points on cued days and 36 on un-cued days).

Behavioural questionnaires. The PRMQ and FBII were repeated to investigate whether the participants and their parents noticed any difference in their PM errors on days that they received the cues in comparison to days that they did not. Participants were asked to think about their abilities only on days when cues were received when completing the questionnaires.

Feedback. Following completion of the study, participants were asked to complete a feedback form (see Appendix G), to evaluate their subjective experience of

the intervention. The feedback form consisted of eleven items, each item being scored on a 10-point Likert scale (0 = Not at all; 10 = Very). For example, questions included how helpful participants found the intervention in supporting their ability to remember to send text messages and to complete their goals, their levels of motivation and effort during the study, and how important it was to them to complete their goals and to send their texts.

Procedure

For those participants recruited through the Paediatric Neuropsychology Department at the Bristol Royal Hospital for Children and through CoRaL Psychology Ltd (Cognitive Rehabilitation and Learning for children and young adults), the information sheet was sent by a member of the clinical care team and potential participants consented to share their contact details with the researcher. For those participants recruited through the Centre for Clinical Neuropsychology Research (CCNR) recruitment website, their parents consented to share their contact details by completing an online form (all information sheets for the study are available in Appendix H). The researcher then first telephoned each potential participant and their parents to provide further information about the study, clarify inclusion and exclusion criteria, and answer any questions, as necessary. An appointment was then arranged at each participant's home to obtain written informed parental consent and adolescent assent, and to gather background information. Participants then completed the neuropsychological assessments. Only the participants who fully met the inclusion criteria were invited to continue with the research.

Participants were asked to send a text message at set times, three times daily for a three or four-week period (excluding weekends), which included the baseline and intervention periods. This will hereafter be called the 'PM task'. PM task times were determined quasi-randomly for each participant and were set during out-of-school

hours. The PM tasks were at least 60-minutes apart and were scheduled in accordance with participants and their parents; times that were inconvenient were excluded from the randomisation. Consistent with Fish et al. (2007) and Rous (2011), errorless learning and vanishing cue techniques were employed to support participants in memorising PM task times (Wilson, Baddeley, Evans, & Shiel, 1994); for example, task times were presented with one digit at a time being withdrawn (e.g., 08:00, then 08:0_).

Participants were also given a timetable of assigned text times, to further ensure that any omissions were more likely due to PM difficulties, rather than not remembering the text times.

Participants were also asked to set 'real-life goals'. These were determined entirely by the participant, with three goals being set each day for the duration of the experiment. Participants were explicitly asked not to use any other external memory aids (such as 'to-do' lists) and parents were asked not to remind their child to engage in the PM task or remember their own real-life PM goals, to ensure that this did not interfere with the intervention. At the end of each day, participants set three goals for the following day, with the support of the researcher via telephone. At the time of setting these new goals, the researcher was aware of whether or not participants would receive content-free cues during the following day, although participants were not provided with this information. Potential limitations of this method shall be considered in the discussion section of this thesis.

The study had a baseline period to reduce task novelty before introducing the intervention. The baseline period initially had a minimum period of six working days (hereafter termed 'baseline period one'), and the exact length of the baseline was determined by participants' performance on the PM task and their goal attainment scores during baseline period one. During this period, participants needed to have at least two days where they only remembered to engage in the PM tasks once (they

completed only 33% of PM tasks or less, on at least two days; and/or they scored two out of six on their goals on at least two days). If a participant continued to perform well on the PM task and their goals after baseline period one, the researcher extended the baseline period for a further six working days (baseline period two). If after baseline period two, any participants continued to perform well on the PM task, they would have been excluded from participating in the research, as it would not be possible to determine the effects of the intervention for these participants due to ceiling effects at baseline. This was not the case for any of the participants, however. One participant's baseline required an extension to 12-working days, which enabled their performance to decline to the required level for inclusion in the intervention phase. The baseline period had a maximum of twelve working days for all participants.

Following the baseline period, participants received brief 'Remembering Goals' Training (RGT; one-hour individual session) to associate receiving text messages reading "STOP" (which means "Stop. Think. Organise. Plan.") to cue them to mentally review their goals for that day (both PM task and personal real-life goals). The training package was delivered by PowerPoint presentation, handout and quiz (see Appendix I) and included psychoeducation of PM, situations where PM failures might occur and why, and a discussion of the importance of stopping when they receive a "STOP" text to mentally review their goals for the day. The training was interactive and contained exercises and discussion to facilitate participant engagement. This training was delivered via Skype to improve access to the intervention. Following the initial RGT session, over the following six working days participants were sent six "STOP" text alerts (cues) on three of the six working days (three cued days and three un-cued days); hereafter termed 'experimental period one'. These texts were sent using an online automated text messaging service (www.textanywhere.net). Texts were sent on randomly selected days to control for potential confounding variables such as practice,

task novelty and after-school activity. The researcher selected cued and uncued days for each participant before they entered the intervention phase using a 'coin toss' randomisation method. The total number of PM tasks engaged in (proportion scores) and accuracy of PM task engagement (composite scores) were recorded each day to yield a measure of PM (see outcome measures). The researcher then provided a 'top up' RGT session on the working day directly following experimental period one. Following this, the experiment continued for a further six working days, where participants were sent six "STOP" text alerts on three randomly allocated days (three cued days and three un-cued days; hereafter termed 'experimental period two'). Again, participants were asked to continue sending their three texts and completing three goals; hereafter termed 'experimental period two'). After experimental period two, the participant PRMQ, Carer PRMQ and the FBII (if applicable) were completed. Each participant and their parents were then debriefed, and the researcher gathered feedback about their experience and acceptability of the intervention.

Data Analysis Plan

Graphs with each participant's performance for the duration of the PM task were created to permit the visual inspection of scores across baseline, cued and un-cued days. Morley and Adams (1991) extol the use of visually examining patterns of graphs, stating that they provide an essential adjunct to the use of statistical analysis in single-case designs. Visual inspections of graphs were, therefore, a key component of the data analysis in the current study.

Prior to statistical analysis, data were also graphed and visually examined for homogeneity of variance, and tests of normality were conducted, in addition to Levene's test for homogeneity of variance. Due to the study's small sample size, it was difficult to be confident that the parametric assumptions were met (Siegel & Castellan, 1988). Non-parametric analyses, therefore, were employed (Todman &

Dugard, 2001). All statistical analyses were carried out using Statistical Package for the Social Sciences (SPSS) Version 22.0 for Macintosh.

As cued and un-cued days were randomly assigned for each participant, and “STOP” alerts were also randomly distributed on cued days, the unit of measurement (PM task engagement) was independent. Consequently Mann-Whitney *U* tests were used to examine the statistical difference between performance between cued and un-cued days (Todman & Dugard, 2001). Mann-Whitney *U* tests were utilised as the test does not require homogeneity of variance or the data to be normally distributed. Standardised effect sizes were also calculated to explore the treatment effect’s strength (Crawford, Garthwaite, & Porter, 2010). Effect sizes were based on the *z* statistic ($r = z / \sqrt{N}$; where $N = 12$; total number of intervention days for each participant, Field, 2013). Classifications of effect sizes were in accordance with Cohen (1988; small = .10; medium = .30; large = .50).

The pre- and post-PRMQ and FBII were utilised for exploratory analysis.

Results

Sample Characteristics

The cognitive assessment results for the eight participants who completed the study are summarised in Table 3. In accordance with Limond et al. (2014), all participants had relatively intact ‘Level A’ and ‘Level B’ cognitive abilities; all SS on the neuropsychological test battery were in the “mildly impaired” range and above. Six participants performed within normal limits on the BADS-C and were included in the study due to their scores on the PRMQ. Seven participants’ scores on the IQ indices were in the average range (Participant 3’s processing speed index was in the “mildly impaired” range). The participants were thus deemed to have the required cognitive abilities to benefit from the intervention, which aims to support metacognition (a ‘Level C’ cognitive ability).

Table 3

Summary of Participants’ Cognitive Assessment Results

Cognitive Domain	Cognitive Assessment	Participant							
		1	2	3	4	5	6	7	8
General Intellectual Functioning	FSIQ ^a (Pro-rated)	108	84	98	105	107	103	102	91
Perceptual Reasoning	WISC-IV Matrix Reasoning ^b Block Design ^b PRI ^a	11	7	9	8	11	10	7	6
		12	10	4	11	15	13	7	8
		110	92	84	98	119	110	82	75
Verbal Comprehension	Vocabulary ^b Similarities ^b VCI ^a	14	10	10	8	13	9	13	10
		12	9	10	12	11	11	16	11
		116	98	99	99	110	99	128	102

Table 3

Continued

Cognitive Domain	Cognitive Assessment		Participant								
			1	2	3	4	5	6	7	8	
Working Memory	WISC-IV	Digit-Span	9	10	10	11	7	8	4*	10	
		Forwards ^b									
		Digit-Span	9	9	9	7	10	7	9	7	
		Backwards ^b									
		Digit Span Total ^b	9	9	9	9	8	7	6	8	
Processing Speed		Digit-Symbol	8	5	8	14	6	11	11	9	
		Coding ^b									
		Symbol Search ^b	11	5	11	12	12	12	12	10	
			PSI ^a	97	73	97	118	94	109	109	97
		D-KEFS Trails	Trails 2 – Number	9	11	10	7	12	8	13	10
	Sequencing ^b										
		Trails 3 – Letter Sequencing ^b	10	4	9	7	11	7	7	13	
Executive Function	D-KEFS Trails	Trails 4 – Number-Letter	8	8	6	11	8	6	11	13	
		Switching ^b									
		BADS-C	Six-Elements ^b	8	8	4	9	8	15	7	5
Verbal Memory	CMS	Stories	11	7	7	6	11	7	9	15	
		Immediate ^b									
		Stories Delayed ^b	13	7	4	7	10	7	9	11	
Attention	TEA-Ch	Walk, Don't Walk ^b	5	8	6	10	9	12	9	7	

Note. FSIQ = Full Scale Intelligence Quotient; WISC-IV = Wechsler Intelligence Scales for Children – Fourth UK Edition; PRI = Perceptual Reasoning Index; VCI = Verbal Comprehension Index; PSI = Processing Speed Index; DKEFS = Delis – Kaplan Executive Function System; BADS-C = Behavioural Assessment of Dysexecutive Syndrome for Children; CMS = Children's Memory Scale; TEA-Ch = Test of Attention for Children

^aIndex Score; ^bScaled Score; *questionable effort during test

Prospective Memory Task Performance

To be able to accurately assess each participant's PM task performance across cued and un-cued days, their reasons for omitting PM tasks were monitored to establish if any omissions were due to reasons other than PM failures (such as a participant losing their phone and being unable to receive content-free cues or send a text, for example). Across all participants, however, all task omissions were deemed to be due to reasons surrounding valid PM failures (such as being 'on autopilot', losing track of the time, or just simply forgetting). Accordingly, no data were excluded from the statistical analysis.

Hypothesis one: Daily prospective memory text messaging task performance. It was hypothesised that participants would show significantly *better* performance on the PM task on days with "STOP" cues in comparison to days without cues; *better* performance was predicted in both the number of PM tasks completed (proportion scores) and the accuracy of PM task timings (composite scores).

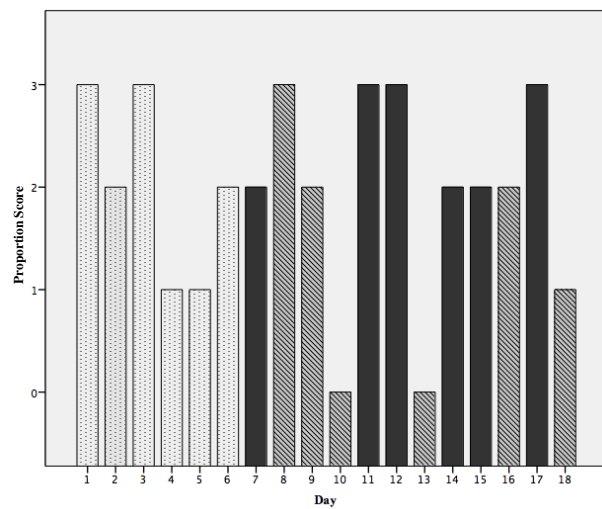
Figures 3 and 4 illustrate the daily proportion scores for all participants across the study. Figures 5 and 6 illustrate the daily composite scores for all participants across the study. It is apparent from visual inspection of these figures that five participants (Participants 1, 2, 3, 5, and 6) demonstrated an improvement in PM task performance (greater proportion and composite scores) on days when they received content-free "STOP" cues, in comparison to un-cued days. Although Participant 8 did not appear to demonstrate an improved proportion score on cued days, visual inspection suggests an improved composite score, in comparison to when no cues were received.

The randomised design was selected to reduce the potential for 'carry-over' effects between cued and un-cued days. To check this, graphs were also inspected for general patterns of 'carry over' effects, to determine if participant performance on un-cued days was superior directly following cued-days, which might suggest participants

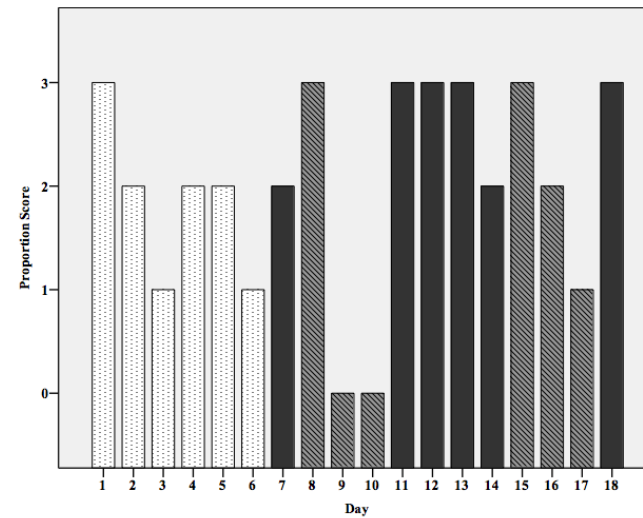
learning to internalise the “STOP” strategy. Four participants (Participants 1, 2, 4, 5) demonstrated at least one occasion of improved performance in proportion and composite scores on an un-cued day when preceded by a cued day. This pattern, however, was not consistent across the intervention. For Participant 4, this only occurred on Day 7 to Day 8 of the intervention, and it did not appear to increase with time (i.e., there was no evidence of more exposure to cued days leading to better performance on un-cued days across the intervention). For some participants (e.g., Participant 5), this did not appear to occur more frequently than other variations in performance (e.g., better performance on un-cued day 10 when preceded by un-cued day 9). Overall, these results suggest limited evidence for ‘carry-over’ effects.

The ‘top-up’ RGT between experimental period one and two did not appear to result in superior text messaging performance during experimental period two (the second half of the intervention), with the exception of Participant 5, who appeared to benefit from repeating the RGT.

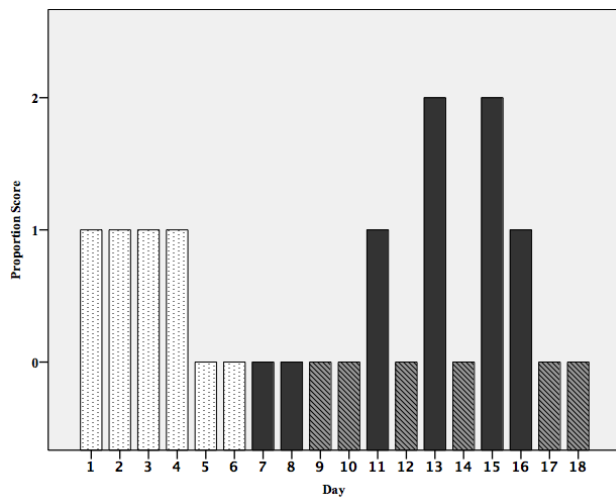
Participant 1:



Participant 2:



Participant 3:



Participant 4:

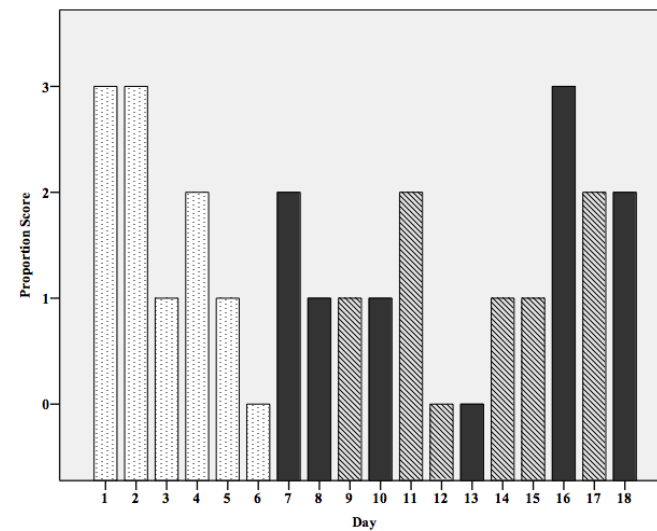
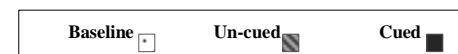
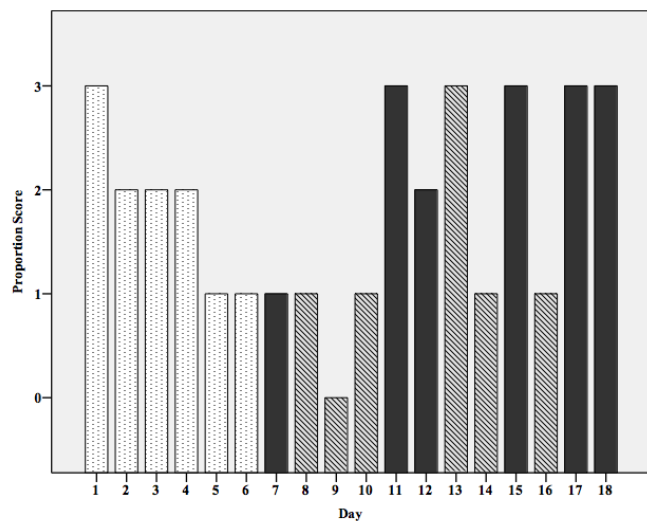


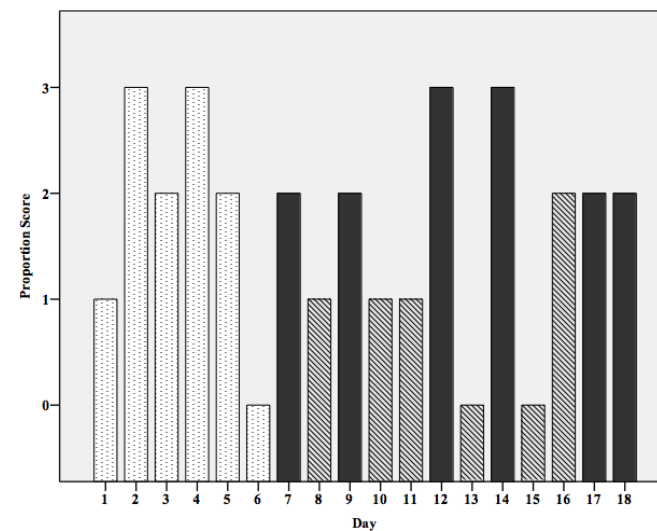
Figure 3. The daily proportion scores for the text messaging PM task for participants one to four.



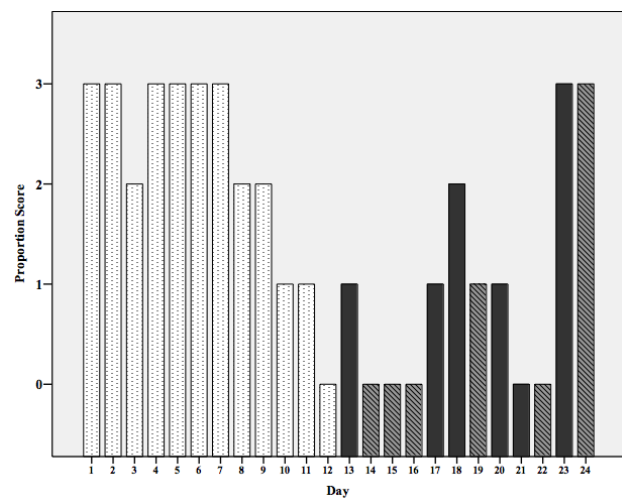
Participant 5:



Participant 6:



Participant 7:



Participant 8:

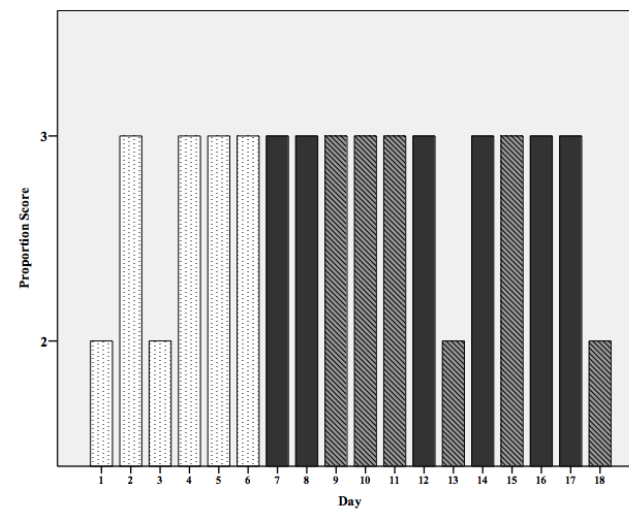
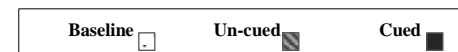
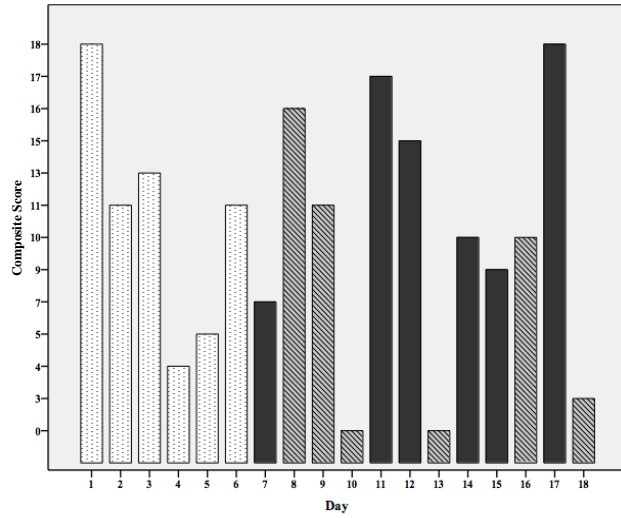


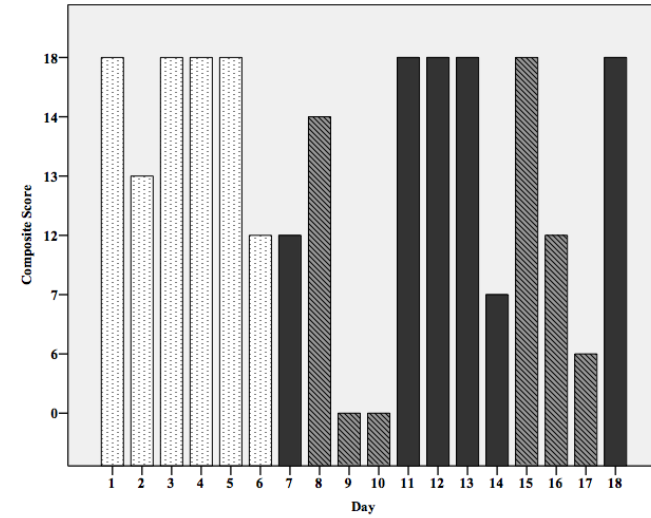
Figure 4. The daily proportion scores for the text messaging PM task for participants five to eight.



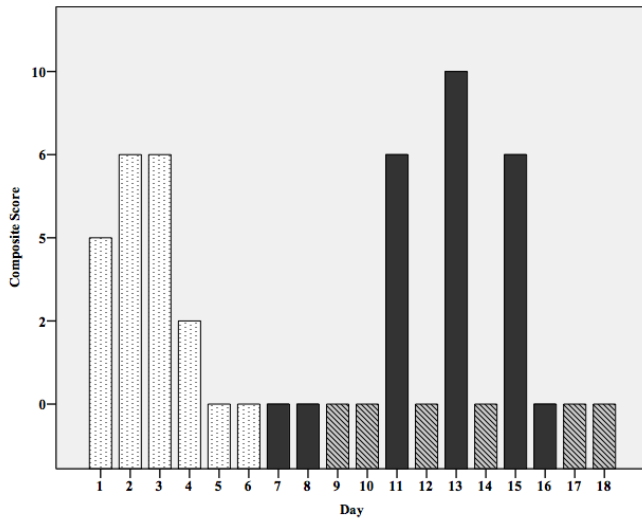
Participant 1:



Participant 2:



Participant 3:



Participant 4:

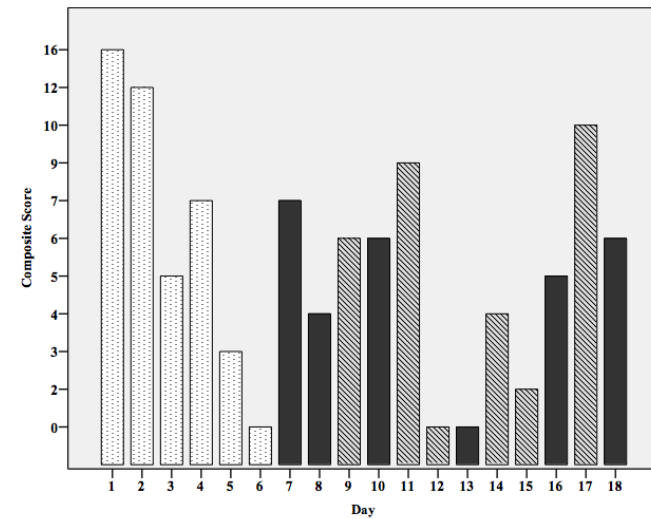
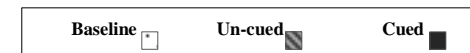
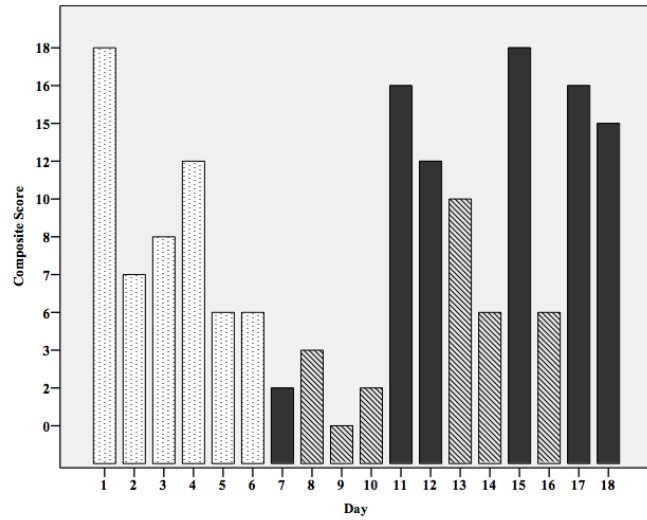


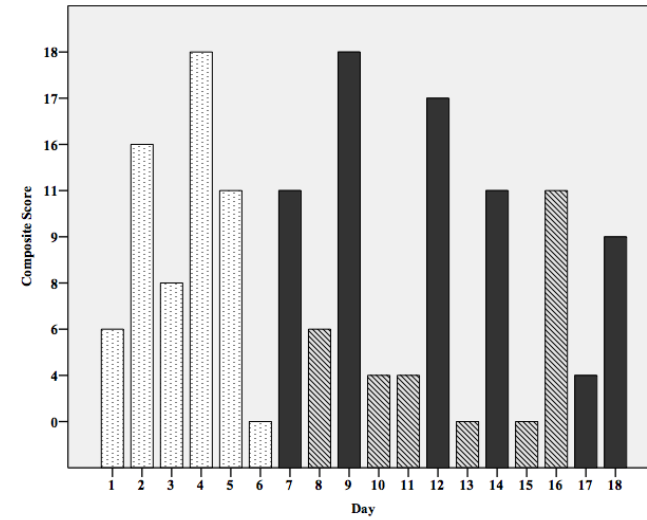
Figure 5. The daily composite scores for the text messaging PM task for participants one to four.



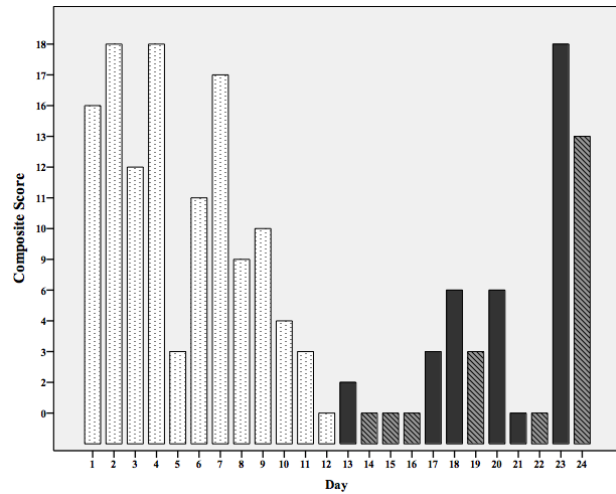
Participant 5:



Participant 6:



Participant 7:



Participant 8:

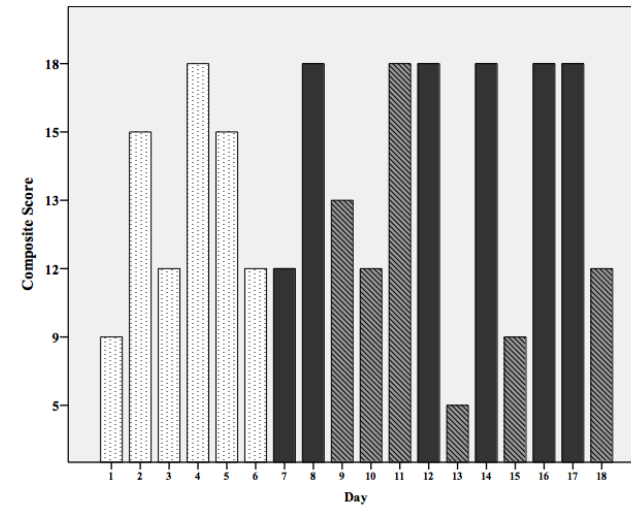
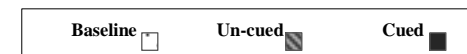


Figure 6. The daily composite scores for the text messaging PM task for participants five to eight.



To analyse the efficacy of content-free cueing on PM task performance, individual Mann-Whitney *U* tests were conducted for each participant. As illustrated in Table 4, three participants (Participants 3, 5, and 6) demonstrated a statistically significant effect of content-free cueing and sent more texts on cued days. The effect sizes for these differences were classified as large. Five participants did not show a statistically significant difference on their proportion scores (Participants 1, 2, 4, 7, and 8).

Table 4

Mann Whitney U Analyses of Proportion Scores (Median and Range Values) Across Cued and Un-cued Days for Each Participant

Participant	Cued days	Un-cued days	<i>U</i>	<i>z</i>	<i>p</i>	<i>r</i>
One	2.5 (2 - 3)	1.5 (0 - 3)	7.50	-1.78	.70	-.51 (large)
Two	3 (2 - 3)	1.5 (0 - 3)	9.00	-1.55	.89	-.45 (medium)
Three	1 (0 - 2)	0 (0 - 0)	6.00	-2.3	.03*	-.66 (large)
Four	1.5 (0 - 3)	1 (0 - 2)	14.50	-.59	.36	-.17 (small)
Five	3 (1 - 3)	1 (0 - 3)	6.00	-2.07	.04*	-.6 (large)
Six	2 (2 - 3)	1 (0 - 2)	2.00	-2.69	.005*	-.78 (large)
Seven	1 (0 - 3)	0 (0 - 3)	10.00	-1.36	.11	-.39 (medium)
Eight	3 (3)	3 (2 - 3)	12.00	-1.48	.23	-.43 (medium)

Note. *r* Effect size is based on the Mann-Whitney *Z* statistic ($r = Z / \sqrt{N}$; Field 2013); **p* < .05; values are exact one-tailed probabilities based on the Mann-Whitney *U* test (Todman & Dugard, 2001).

Analysis of composite scores revealed that four participants (Participants 2, 5, 6, and 8) demonstrated a statistically significant effect of content-free cueing and were more accurate in the timings of sending their texts on cued days (see Table 5). The effect sizes for these differences were classified as large for these participants. Four participants did not show a statistically significant difference on their composite scores (Participants 1, 3, 4, and 7).

Table 5

Mann Whitney U Analyses of Composite Scores (Median and Range Values) Across Cued and Un-cued Days for Each Participant

Participant	Cued days	Uncued days	<i>U</i>	<i>z</i>	<i>p</i>	<i>r</i>
One	12.5 (7 – 18)	6.5 (0 – 18)	9.50	-1.37	.1	-.4 (medium)
Two	18 (7 - 18)	9 (0 - 18)	7.50	-1.75	.05*	-.51 (large)
Three	3 (0 – 10)	0 (0 – 0)	9.00	-1.9	.09	-.55 (large)
Four	5.5 (0 – 7)	5 (0 – 10)	17.00	-.16	.46	-.05 (small)
Five	15.5 (2 - 18)	4.5 (0 - 10)	4.50	-2.17	.01*	-.63 (large)
Six	11 (4 - 18)	4 (0 - 11)	5.00	-2.12	.02*	-.61 (large)
Seven	4.5 (0 - 18)	0 (0 – 13)	9.50	-1.42	.09	-.41 (medium)
Eight	18 (12 – 18)	12 (5 – 18)	5.5	-2.15	.03*	-.62 (large)

Note. *r* Effect size is based on the Mann-Whitney *Z* statistic ($r = Z/\sqrt{N}$; Field 2013); * $p \leq .05$; values are exact one-tailed probabilities based on the Mann-Whitney *U* test (Todman & Dugard, 2001).

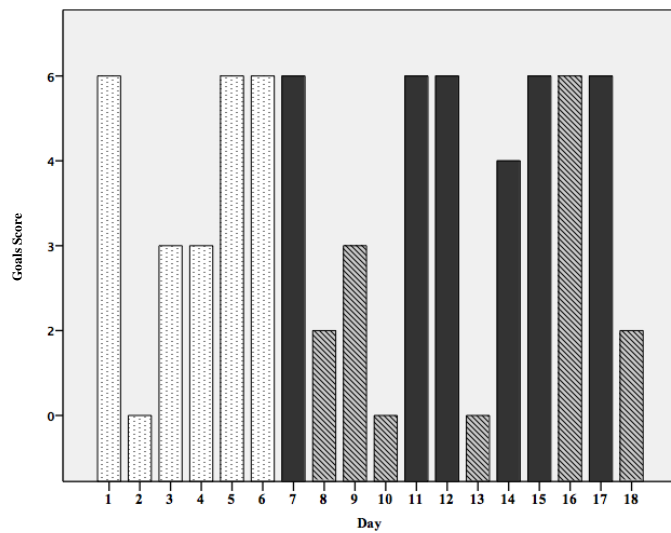
Hypothesis two: Daily prospective memory real-life goal task performance.

Figures 7 and 8 illustrate the daily real-life goals PM task scores for all participants across the study. Visual inspection of these figures suggests that all participants demonstrated an improvement in their real-life goal performance on days when they received content-free “STOP” cues.

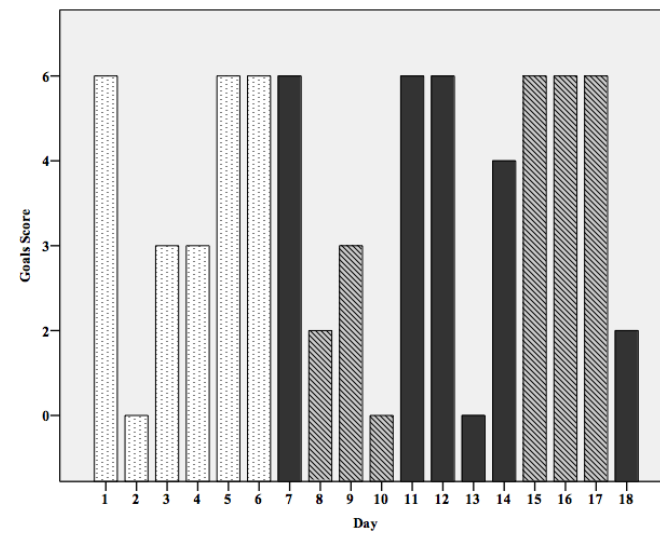
As above, graphs were also inspected for potential ‘carry over’ effects to determine if participant goal performance on un-cued days was superior directly following cued-days, which might suggest participants learning to internalise the strategy to complete their goals. Four participants (Participants 2, 3 4, and 6) demonstrated patterns of improved performance in goals scores on such occasions. As with the PM text messaging task data, this pattern, however, was not consistent across the intervention, did not appear to increase with time (i.e., exposure to the cued days), and for some participants (Participant 2), did not appear to occur more frequently than other variations in performance. Overall, these results suggest limited evidence for ‘carry-over’ effects.

The ‘top-up’ RGT between experimental period one and two did not result in superior performance during experimental period two (the second half of the intervention), with the exception of Participant 4 who appeared to benefit from repeating the RGT.

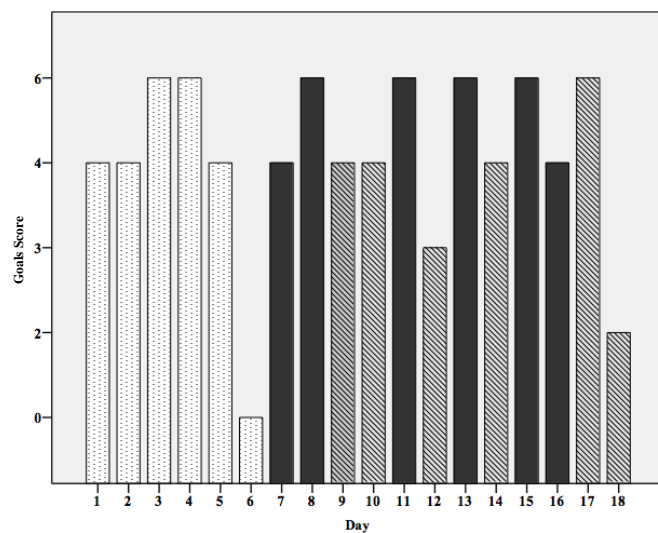
Participant 1:



Participant 2:



Participant 3:



Participant 4:

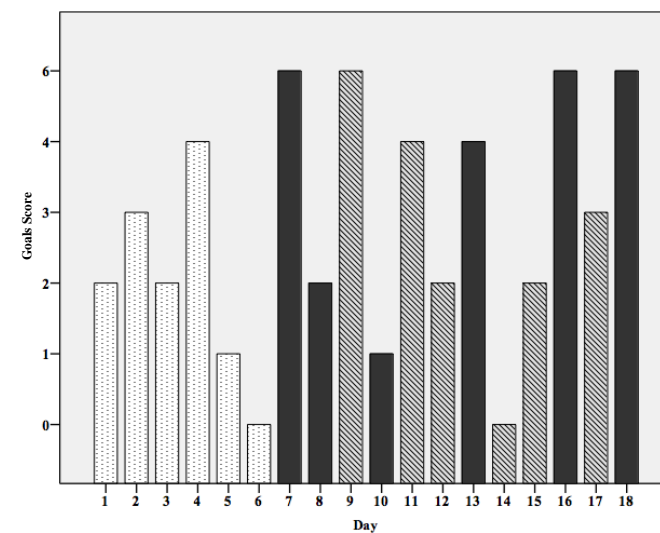
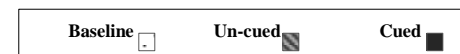
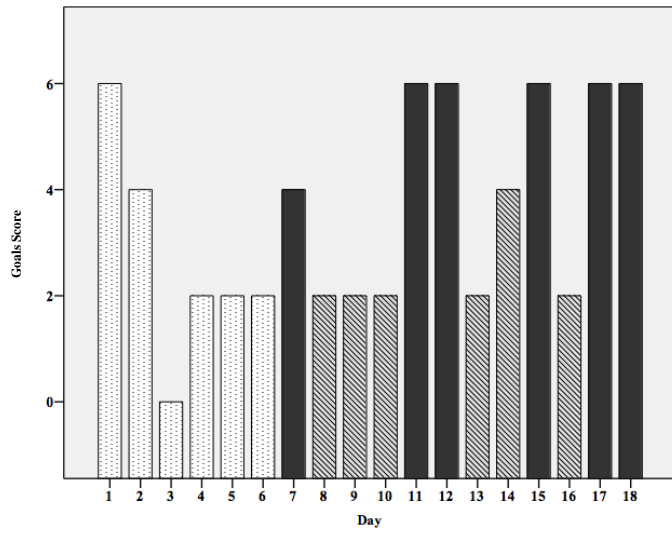


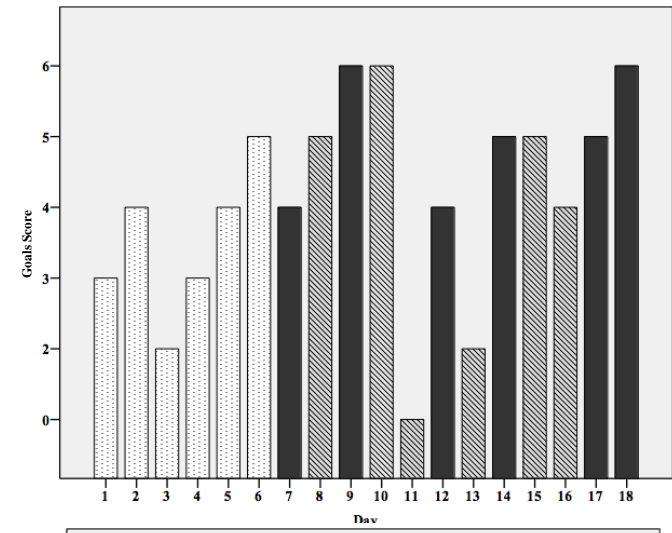
Figure 7. The daily real-life goal PM task performance for participants one to four.



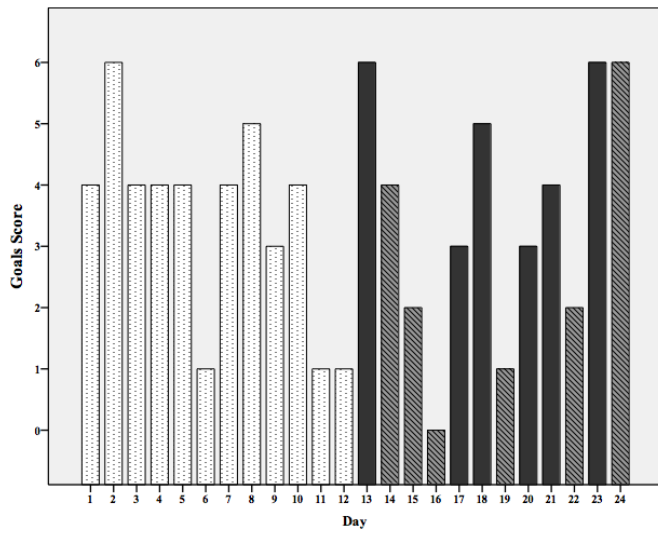
Participant 5:



Participant 6:



Participant 7:



Participant 8:

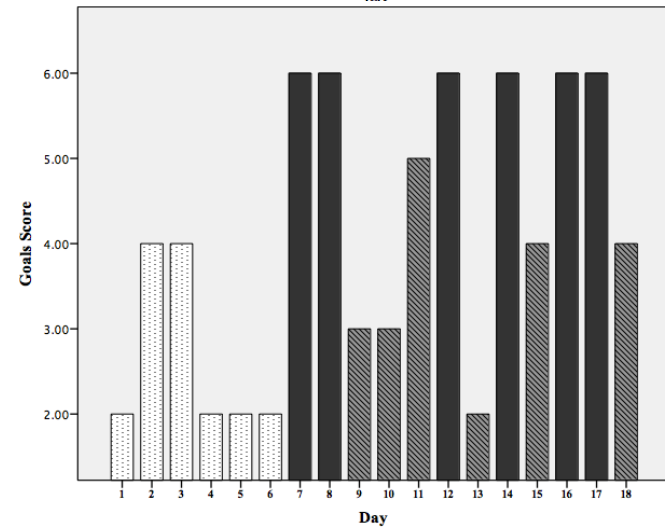
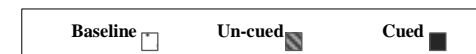


Figure 8. The daily real-life goal PM task performance for participants five to eight.



To analyse the efficacy of content-free cueing on the achievement of real-life goals, individual Mann-Whitney *U* tests were conducted for each participant. As illustrated in Table 6, four participants (Participants 1, 2, 5, and 8) demonstrated a statistically significant effect of content-free cueing and achieved more of their real-life goals on cued days. The effect sizes for these differences were classified as large for these participants. Four participants did not show a statistically significant difference on their composite scores (Participants 3, 4, 6, and 7).

Table 6

Mann Whitney U Analyses of Real-Life Goal Scores (Median and Range Values) Across Cued and Un-cued Days for Each Participant

Participant	Cued days	Un-cued days	<i>U</i>	<i>z</i>	<i>p</i>	<i>r</i>
One	6 (4 - 6)	2 (0 - 6)	3.50	-2.49	.008*	-.72 (large)
Two	5 (4 - 6)	4 (0-5)	6.00	-2.01	.040*	-.58 (large)
Three	6 (4 -6)	4 (2 -6)	7.00	-1.90	.06	-.55 (large)
Four	5 (1 - 6)	2.5 (0 - 6)	12.00	-.99	.18	-.27 (small)
Five	6 (4 - 6)	2 (2 - 4)	.50	-3.03	.002*	-.88 (large)
Six	5 (4 - 6)	4.5 (0 - 6)	12.00	-.99	.2	-.29 (medium)
Seven	4.5 (3 - 6)	2 (0 - 6)	7.50	-1.7	.06	-.49 (medium)
Eight	6 (6)	3.5 (2 - 5)	0	-3.09	.001*	-.89 (large)

Note. *r* Effect size is based on the Mann-Whitney *Z* statistic ($r = Z / \sqrt{N}$; Field 2013); **p* <.05; values are exact one-tailed probabilities based on the Mann-Whitney *U* test (Todman & Dugard, 2001).

Exploratory Analysis of Subjective Rating Scales

Table 7 presents the results of the Participant PRMQ, Carer PRMQ and the FBII that were completed pre- and post-intervention. The FBII was not completed by the parents of participants with PM difficulties with unknown aetiology (no known neurological condition). Participant 3 did not complete follow-up questionnaires due to disengagement from the study. As is illustrated in the table, six participants and their parents showed an improvement in their subjective ratings (reduction in their scores) on the PRMQ. Three participants (Participants 1, 2, and 4) whose parents completed the FBII reported a reduction in family burden post-intervention. Participant 6 and their parent's scores increased on the PRMQ and FBII, suggesting a worsening of symptoms post-intervention.

Table 7

Summary of Participants' Scores on the Participant PRMQ, Carer PRMQ and FBII (Pre- and Post- Intervention)

Participant	Measure		Pre-Intervention		Post-Intervention	Change in Scores	
One	Participant	P	27	P	25	-2	
		R	21	R	19	-2	
		T	48	T	44	-4	
	Carer PRMQ	P	37	P	28	-9	
		R	29	R	26	-3	
		T	66	T	54	-12	
	FBII		51		34	-17	
	Two	Participant	P	24	P	16	-8
			R	23	R	11	-12
T			47	T	27	-20	
Carer PRMQ		P	35	P	24	-11	
		R	15	R	9	-6	
		T	50	T	33	-17	
FBII			30		14	-16	
Three		Participant	P	35	P	-	-
			R	30	R	-	-
	T		65	T	-	-	
	Carer PRMQ	P	40	P	-	-	
		R	32	R	-	-	
		T	72	T	-	-	
	FBII		20		-	-	

Table 7

Continued

Participant	Measure		Pre-Intervention		Post-Intervention	Change in Scores	
Four	Participant	P	26	P	11	-15	
		R	19	R	9	-10	
		T	45	T	20	-25	
	Carer PRMQ	P	25	P	19	-6	
		R	20	R	12	-8	
		T	45	T	31	-14	
	FBII		22		14	-8	
	Five	Participant	P	23	P	12	-11
			R	18	R	16	-2
T			41	T	28	-13	
Carer PRMQ		P	29	P	19	-10	
		R	15	R	15	0	
		T	44	T	34	-10	
Six	Participant	P	21	P	29	+8	
		R	25	R	25	0	
		T	46	T	54	+8	
	Carer PRMQ	P	30	P	32	+2	
		R	26	R	29	+3	
		T	56	T	61	+5	
FBII		68		69	+1		

Table 7

Continued

Participant	Measure		Pre-Intervention		Post-Intervention	Change in Scores
Seven	Participant	P	32	P	30	-2
		R	24	R	23	-1
		T	56	T	53	-3
	Carer PRMQ	P	34	P	33	-1
		R	28	R	28	0
		T	62	T	61	-1
Eight	Participant	P	26	P	16	-10
		R	19	R	18	-1
		T	45	T	34	-11
	Carer PRMQ	P	28	P	21	-7
		R	23	R	20	-3
		T	51	T	41	-10

Note. A minus score on the 'Change in Scores' column denotes an improvement in memory functioning.

FBII = Family Burden of Injury Interview; R= Retrospective Scale Total; P = Prospective Scale Total; PRMQ = Prospective and Retrospective Memory Scale; T = Total Score of PRMQ

Qualitative feedback. Some of the subjective experiences of participants during the intervention are provided in Appendix J. Overall, all participants reported finding the intervention helpful in supporting their PM functioning and all reportedly enjoyed taking part in the study. Furthermore, all participants and their parents requested further advice about how to incorporate the “STOP” strategy into their daily lives once they stopped participating in the study. Following completion of the intervention, participants were asked to complete a questionnaire (see Appendix K) regarding their opinions of the efficacy of the intervention for supporting their PM functioning. This subjective feedback shall be utilised alongside the data analyses to draw conclusions regarding participant performance in the Discussion.

Discussion

Based on previous findings (Fish et al., 2007; Rous, 2011), this study predicted that participants would show significantly better performance on the PM task on days when “STOP” cues were received by participants, in comparison to days without cues; better performance was predicted in both the number of PM tasks completed and the accuracy of PM task timings. This hypothesis was partially supported in that, for five participants (Participants 1, 2, 3, 5, and 6), there was a clear pattern of improved performance in both their proportion and composite scores based on visual inspection of the data (graphs). Further statistical analysis revealed that, for Participants 3, 5, and 6, there was a significant difference in the proportion scores on cued days with large effect sizes. For Participants 2, 5, 6, and 8, there was a significant difference in their composite scores on cued days with large effects.

Although Participants 4 and 7 did not show an improved performance on cued days as hypothesised, and, although Participant 8 did not show improved proportion scores on cued days, there are potential explanations for this. Part way through the intervention, Participant 4 broke his ankle, which reportedly impacted upon his ability to engage in the task. Furthermore, he was being investigated for epilepsy at the time of the study. According to Limond et al.’s (2014) model of paediatric neurocognitive interventions, to benefit from cognitive intervention, a child must have intact *psychosocial and systemic foundations*. It is plausible that the life stress of his current injury, in addition to the on-going uncertainty of his diagnosis, might have meant that he was unable to benefit from the cognitive intervention. For Participant 7, her baseline was extended to 12-working days, as she did not reach the cut-off criteria during the initial 6-working day baseline period and her scores only reduced to baseline upon commencing her Easter Holidays. During her Easter Holidays, she commented that her regular routine and environment (where she would typically structure and plan

her activities) was removed, as she was not going to school. She commented that her PM difficulties are worsened when she has no routine, such as during the weekend. It is possible, therefore, that she may not have reached cut-off criteria if the baseline had ended before the Easter Holidays. She reported that, although she found the “STOP” texts helpful, she did not receive them frequently enough for them to help her during busier, routine-free times, with novel daily distractions, such as during the Easter Holidays. For Participant 8, his scores on the text message task did not reduce to cut-off during baseline and he was only included in the study as his scores on the goals task reached cut-off in the final two days of the baseline. It could, therefore, be argued that we would not expect to see a difference in his proportion scores, as he was not experiencing PM difficulties for this task during baseline, perhaps due to task novelty.

The second hypothesis, that participants would achieve more of their real-life goals on days when they received “STOP” cues, was partially supported in that there was a clear pattern of improved performance in all participants’ goal scores based on visual inspection of the data (graphs). Further statistical analysis revealed that there was a significant difference in the goals scores on cued days with large effect sizes for Participants 1, 2, 5, and 7. Participant 4’s engagement in this task may have been affected in the same manner as his performance on the text-messaging task (discussed previously).

Most of the participants reported positive gains in self-reported PM abilities, and most parents of children with acquired neurological conditions reported reduced levels of stress and burden following the intervention. Participant 6 and their parent, however, reported a worsening of symptoms following the intervention. This increase in scores could be a result of test-retest reliability issues. For example, following the intervention they may have developed a better understanding of the concepts that the questionnaires were measuring and so they were able to provide a more detailed and

accurate account of the participant's difficulties. The increase in scores may also reflect an increased awareness of difficulties following a month of focussing on difficulties and recording PM errors. It is also worth noting, however, that the test-retest reliability data for the PRMQ were based on adult normative data, thus the increase in scores might be within the margin of measurement error for the questionnaire when used with parents of children and young people. Qualitative feedback from the participants and their parents, suggested that the intervention was acceptable and engaging, with all participants requesting to continue with the "STOP" cues post-intervention.

The findings will next be discussed in relation to the methodological limitations, and future research directions and implications of the study will be also considered.

Methodological Critique and Directions for Future Research

Evaluation of the study design. By employing a single-case design, this study permitted the exploration of the research hypotheses by documenting individualised outcomes to support the rehabilitation approach. A single-case design with randomised-alternating treatment was utilised, and the text message times, the order of the cued and un-cued days, and the timing of the "STOP" texts were randomised for each participant, which increased the internal validity of the study and limited any carry-over effects of the intervention. Consistent with Fish et al. (2007) and Rous (2011), to prevent potential interference from retrospective memory failures impacting on task performance, errorless learning techniques and vanishing cues (Wilson et al., 1994) were employed to support participants to remember the times of their three prospective text messages. Participants were also given a written record of this. Unlike the study by Rous (2011), the six or 12-day baseline period in the current study reduced the impact of task novelty as a potential confounding variable. Other strengths of the study design, which improved on the design of Rous (2011) were: i) the RGT metacognitive training component was repeated half-way through the intervention

ensuring that participants maintained their understanding of the purpose of the “STOP” cue; ii) ‘real-life’ goals were included as an outcome measure to investigate transfer to social participation (a priority outcome for clinical interventions), and the researcher supported participants every evening to set new goals for the following day. This ensured consistency of goal setting and ratings for the duration of the study, which is likely to have facilitated the participants’ engagement with the study; iii) the RGT training was delivered via Skype to improve access to the intervention, and; iv) after conducting a focus group, the PM task was altered from a phone call task to a text message task, which was deemed to be more *adolescent friendly*. The study also had strong ecological validity, as it was completed over a month-period in participant’s own home- and school-environments.

A limitation in the current study design is that there was limited opportunity to explore whether the combination of RGT and content-free cueing resulted in transfer effects, as the intervention was not permanently removed during the study. Future research may, therefore, seek to employ an A-B-A-B design, to better establish whether such transfer effects occur. A further limitation is that participants completed the neuropsychological assessment and RGT in their own home. Although steps were taken to prevent distractions impacting upon participant performance, the participants’ homes arguably had greater distractions than a clinical or laboratory setting. Future research may wish to consider this when determining locations to conduct screening assessments. As testing environments were consistent across all participants, this potential threat to internal validity is, however, minimized (Field, 2013).

Evaluation of measures, sample and analyses. A strength in this study is that information was gathered from multiple sources regarding each participants cognitive functioning, including neuropsychological assessments, clinical interviews, and self-report questionnaires (both parent and participant), in line with good practice guidelines

(Middleton, 2002). Furthermore, participants were screened based on their cognitive profile, to ensure they had the cognitive abilities necessary to benefit from the intervention, in accordance with Limond et al.'s (2014) model of paediatric neurocognitive interventions. A potential limitation, however, surrounds the use of the PRMQ as an eligibility criterion for inclusion in the study. Normative data for a paediatric population is unavailable, and the PRMQ was selected due to the limited availability of subjective screening measures for assessing PM deficits. Although using the PRMQ provides an effective subjective measure of PM deficits, collecting normative data for this questionnaire with a paediatric population would be a helpful direction for future research. In addition, future research investigating PM interventions may also wish to employ a standardised PM measure, such as the Appointments subtest from the Rivermead Behavioural Memory Test for Children (RBMT-C; Wilson, Ivani-Chalian, & Aldrich, 1991; Wilson, Ivani-Chalian, Besag, & Bryant, 1993). The Appointments subtest was not utilised in the current study because the BADS-C and PRMQ were considered to provide a comprehensive assessment of PM (both the memory and executive components). Future studies might, however, want to characterise PM using a number of measures including the PM elements of the RBMT-C.

A potential limitation in this study was that the researcher was aware of the cueing schedule when contacting participants to set real-life goals. In accordance with the Consolidated Standards of Reporting Trials (CONSORT; The CONSORT Group, 2010) guidelines, in a gold standard design the researcher would be blind to the intervention condition. It was not possible, however, to provide this level of blindness due to limited resources and given the remit of this doctoral thesis. Every effort was made by the researcher to ensure that participants remained unaware of the cueing schedule (thus minimising any potential bias) when setting their goals. Future research

may address this potential limitation by utilising an independent researcher to set the cues so that the researcher can remain blind to the cueing schedule when assessing and eliciting daily goals from the participant.

The majority of previous research into PM difficulties has focussed solely on ABI (Fish et al., 2007; Rous, 2011; Wilson et al., 2009), and although these studies provide evidence in support of interventions for PM deficits following ABI, it is not possible to reliably state whether other populations might benefit from the intervention. Participants in the study were recruited solely on whether they experienced PM difficulties, regardless of the aetiology. This means that this study has provided evidence for rehabilitating PM difficulties in a varied population, and is arguably applicable as a rehabilitation approach for all who experience PM difficulties. However, a limitation in the current study is that, due to the small sample size, the study was not powered to explore the potential impact of participant characteristics (e.g., the impact of their cognitive abilities, age, aetiology) on their PM task performance. Further research may wish to explore this further, to determine the patient groups that benefit the most from the intervention.

As the study only recruited eight participants, it is difficult to reliably generalise the findings to larger samples. It is, therefore, important that future research build upon the findings of this single-case study by conducting a randomised control trial using this intervention (that now has a proof-of-principle based on these single-case findings). This would allow future research to further explore the effectiveness of content-free cueing and RGT on PM performance, and to establish the intervention's generalisability to large sample sizes.

A strength in the analysis in this study was that data were analysed utilising multiple methods. Data was first visually inspected for patterns, in addition to analysing participant mean performance and further statistical analysis, which is the

recommended *gold standard approach* for single-case designs (Morley & Adams, 1991). This ensured that data were considered in detail, rather than relying on any individual component (such the statistical analysis) in isolation. For single-case methods, using a single approach to analysis could result in incorrect assumptions (such as incorrectly assuming the data as demonstrating insignificant findings, when clear patterns are, in fact, present in the data). Furthermore, as highlighted in the review paper in the present thesis, few studies have reported ES for interventions, which thus limit one's ability to discuss the magnitude of the effect of the intervention. A strength of this study is that ES were calculated.

Theoretical and Clinical Implications and Future Directions

The findings of the current study demonstrate some promising evidence for the efficacy of content-free cueing and RGT for facilitating PM functioning for some children and adolescents who experience PM deficits. It remains unclear, however, if the participants who demonstrated some PM improvements would continue to benefit from cues in the longer term. For example, if content-free cues were continued to be used in everyday life, it is possible that their benefit might diminish as participants habituated to the cues or lost motivation in utilising the cues. Furthermore, not all participants benefited from the content-free cues, suggesting that individual differences might be a factor in determining the efficacy of the intervention. It remains unclear, however, what these individual factors might be. One of the findings of the current research is that there appears to be no clear pattern of different diagnoses having better outcome on the intervention (e.g., the results do not suggest that only individuals with ABI benefit and those with epilepsy do not). Clinically, this has strong implications for the patient groups with whom the intervention can be utilised, and clinicians may not need to be concerned about the cause of an individual's difficulties when considering the intervention. Instead, the current research suggests that it is the *characteristics and*

environmental factors of the individual that need to be considered when determining the efficacy and appropriateness of the intervention, as is also suggested by Limond et al. (2014).

All participants reported that the content-free cues were helpful in achieving their real-life goals (as is reflected in the participant performance on this task). All participants, however, also reported a belief that having more frequent “STOP” cues may have improved their performance on the text-messaging task, where they were required to engage in a PM task at a set time. This suggests that, for this particular task, participants may have preferred content-specific, task-based cues to facilitate PM task performance (although future research would need to investigate this further to state this with any degree of certainty). It could, therefore, be argued that different types of compensatory or metacognitive strategies may be preferential and result in superior PM performance, depending on the task itself (e.g., if the task needs to be completed a certain time). Future research may, therefore, wish to investigate the efficacy of different types of strategies (e.g., content-free and RGT versus content-specific cues) on PM task performance. It could be argued that, in the current study, the content-free cues were not being used for metacognitive purposes, and were, in fact, operating as task-based cues. There were, however, no evidence that this was the case in terms of the timings that they received a “STOP” cue and sending a text message. Furthermore, the researcher attempted to mitigate against this by ensuring a delay between participants receiving a “STOP” cue and having to send a text message. It is important to note, however, that all participants commented that the content-free cues facilitated their independence, without the need for “being told what to do”.

For some participants, although their performance did not significantly improve following the intervention, they reported a belief that their experience of everyday PM failures reduced. This could be due to participants wishing to appease the researcher

(social desirability factors), but it could also be that measuring a behaviour becomes an intervention itself, that engaging with an intervention, however effective, might empower participants and encourage feelings of control over their difficulties. Furthermore, with Participant 6 (who reported an increase in their experience of PM failures in the PRMQ), the intervention, no matter how helpful, may have increased their awareness of the extent of their PM deficits, thus reducing the reliability of employing outcome measures in clinical practice.

Previous PM intervention studies (Wilson, Emslie, Quirk, Evans, & Watson, 2005; Wilson et al., 2009; Emslie, Wilson, Quirk, Evans, & Watson, 2007) have provided evidence of PM interventions resulting in transfer effects when the compensatory strategy was removed entirely. These findings, therefore, raised an interesting theoretical question about whether external memory strategies designed to compensate for PM deficits can facilitate the remediation of PM functioning. It is, currently, unclear if the participants in these studies internalised a memory strategy to support PM, developed a habit or routine and thus minimised the PM demands, or developed PM skills, as a result of the repeated use of an external memory aid. The current study was not designed to address this question (see limitations above), and inspection of the data suggested limited evidence for transfer between cued to un-cued days, consistent with the randomised design employed. Future research may seek to answer whether participants demonstrate PM improvements with RGT alone. This could then provide evidence towards the debate of whether PM is a skill that can be taught or whether it can only be facilitated through external strategies.

A promising finding of this research is that content-free cueing and RGT facilitated the achievement of real-life goals for seven of the eight participants. These goals were unique to the individual, and were not directly incorporated into the training and intervention, which suggests that the intervention may be generalisable to

everyday life. Indeed, all seven participants and their parents who were available for feedback, regardless of their performance on the PM tasks, sought advice on how they could incorporate the “STOP” strategy into their daily lives after the study was complete.

This study provides evidence to suggest that a cognitive intervention can be administered via Skype, without the need for face-to-face appointments, thus increasing the accessibility and reducing the cost of delivery of the intervention. This, therefore, offers a promising platform on which to explore the efficacy of wider interventions being delivered via telecommunication devices, utilising the increase in widely available compatible devices (such as Smartphones and Tablet devices).

Conclusion

The investigation of PM interventions for a paediatric population is largely under researched. To the author’s knowledge, no research has been conducted surrounding the rehabilitation of PM deficits as a result of epilepsy or of an unknown aetiology. This research is, therefore, novel and offers evidence in support of the efficacy of content-free cueing and RGT for facilitating PM abilities.

Five of the eight participants engaged in more frequent and accurate PM tasks and achieved more of their real-life goals on days when they received content-free cues. Furthermore, the method of delivering the intervention via Skype offers support for the delivery of rehabilitation of PM without the need for face-to-face contact. Future researchers may wish to explore whether content-specific cues are a superior (or preferred) compensatory strategy for certain time-based activities. This study, however, provides some promising evidence that metacognitive abilities, such as PM, can be improved in some adolescents without the need for content-specific cues.

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Appendices

- A. Description of Recruitment Difficulties**
- B. Flow Diagram of Recruitment Process**
- C. Proof of NHS and University Ethics Approval**
- D. Risk Protocol**
- E. Clinical Interview Proforma**
- F. Psychometric Properties of Neurocognitive Assessment**
- G. Intervention Feedback Form**
- H. Information Sheets**
- I. GMT Presentation and Handout**
- J. Summary of Qualitative Feedback**
- K. Subjective Experiences of Intervention**
- L. Dissemination Statement**

A. Description of Recruitment Difficulties

Recruitment began within the Paediatric Neuropsychology Service at Bristol Royal Hospital for Children. It began with retrospective screening of all of the cognitive reports of patients seen within the previous five years (approximately 400 reports were screened) initially. All reports were screened according to inclusion and exclusion criteria for the study, and any patients who appeared to meet the criteria were sent a study pack by a member of the clinical care team. Response rate by this method of recruitment was, unfortunately, very low; 43 patients were invited to participate and only five patients expressed an interest in the study.

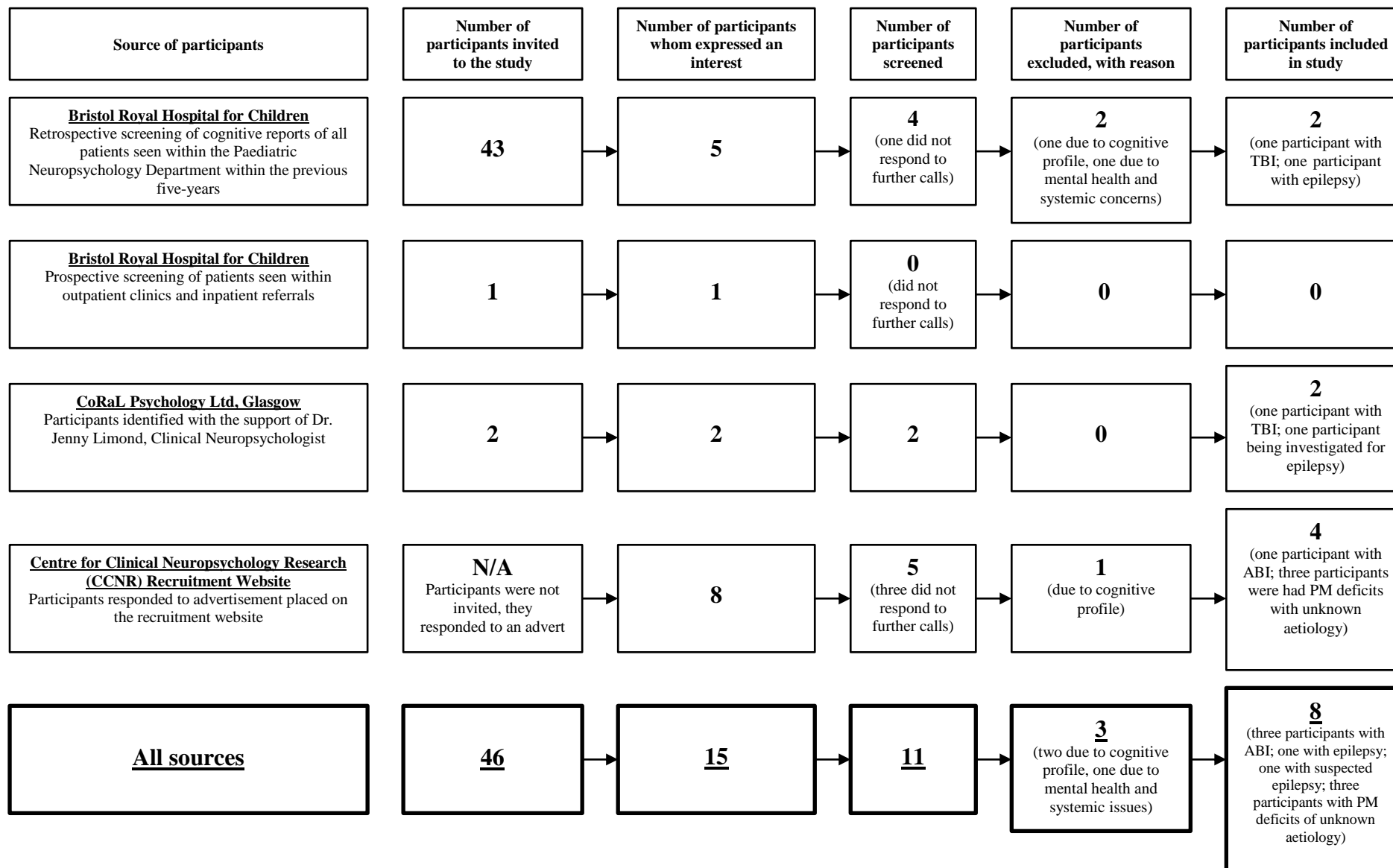
Prospective recruitment of patients through the Paediatric Neuropsychology outpatient clinics at Bristol Royal Hospital for Children was also extremely limited. At the time of recruitment, the service hosting the research had recently relocated from another hospital, and administrative and political challenges within the service meant that the research could not be adequately supported within the department; for example, there was a long period of time where no patients were booked into the clinic slots due to repeated administrative errors. No participants were recruited using this method.

Due to these recruitment difficulties, the inclusion criteria for the study were amended so that participants could now have an ABI, epilepsy, or have PM deficits of unknown aetiology. The rationale being that the evidence base suggests that these populations can experience PM deficits and it would be interesting to establish if the intervention could support PM rehabilitation, regardless of aetiology or cause of the deficits. NHS and University ethics had to be re-submitted accordingly.

Recruitment methods were extended to include online recruitment and word-of-mouth recruitment via a private rehabilitation practice. This involved travelling to Scotland for recruitment for one participant, who sadly did not meet criteria for the study.

Ultimately, eleven participants were screened for the study in Devon, Bristol, Gloucestershire, Durham and Scotland, with eight participants completing the study.

B. Flow Diagram of Recruitment Process



Running Header: THESIS
Trainee Number: 12/01017

C. Proof of NHS and University Ethics Approval



Health Research Authority

NRES Committee South West – Central Bristol

Whitefriars
Level 3, Block B
Lewin's Mead
Bristol
BS1 2NT

Email: nrescommittee.southwest-bristol@nhs.net

Telephone: 0117 342 1335

02 September 2014

Mr Steven Mahan
School of Psychology
Washington Singer Building
University of Exeter
Exeter
Devon
EX4 4QG

Dear Mr Mahan

Study title: Content-Free Cueing and 'Remembering Goals' Training:
The Rehabilitation of Prospective Memory Deficits
Following Paediatric Acquired Brain Injury

REC reference: 14/SW/1008

IRAS project ID: 150366

Thank you for your letter responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Vice-Chair.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to make a request to postpone publication, please contact the REC Manager, Mrs Naaz Nathoo, nrescommittee.southwest-bristol@nhs.net.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
Copies of advertisement materials for research participants [Recruitment Poster]	1	04 April 2014
Evidence of Sponsor Insurance or Indemnity (non NHS Sponsors only) [Evidence of Insurance]	1	16 August 2013
GP/consultant Information sheets or letters [Letter to GP]	1	01 April 2014
IRAS Checklist XML [Checklist_05062014]		05 June 2014
IRAS Checklist XML [Checklist_18082014]		18 August 2014
IRAS Checklist XML [Checklist_11082014]		11 August 2014
Letter from sponsor [Sponsor Letter]	1	14 April 2014
Other [Research Supervisor CV]	1	30 March 2014
Other [Public Liability Letter]	1	19 July 2013
Other [Consent to Contact (Parent)]	1	04 April 2014
Other [14 SW 1008 Email to the researcher requesting tracked changes]		14 August 2014
Participant consent form [Parental Consent Form]	1	04 April 2014
Participant consent form [Participant Consent Form (16-17 years)]	1	04 April 2014
Participant consent form [Assent Form (12-15)]	1	04 April 2014
Participant Information sheet (PIS) [Parent Information Sheet]	2	11 August 2014
Participant Information sheet (PIS) [Participant Information Sheet (12-15)]	2	11 August 2014
Participant Information sheet (PIS) [Participant Information Sheet (16-17 years)]	2	11 August 2014
REC Application Form [REC_Form_05062014]		05 June 2014
Research protocol or project proposal [Research Proposal Written Summary - Steven Mahan]		
Summary CV for Chief Investigator (CI) [Chief Investigator CV]	1	30 March 2014
Summary CV for student [Student/Chief Investigator CV]	1	30 March 2014
Summary CV for supervisor (student research) [Field Collaborator CV]	1	01 April 2014
Validated questionnaire [PRMQ proxy]		
Validated questionnaire [FBII short form]		
Validated questionnaire [PRMQ self]		

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document "*After ethical review – guidance for researchers*" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The HRA website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

User Feedback

The Health Research Authority is continually striving to provide a high quality service to all applicants and sponsors. You are invited to give your view of the service you have received and the application procedure. If you wish to make your views known please use the feedback form available on the HRA website:

<http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance/>

HRA Training

We are pleased to welcome researchers and R&D staff at our training days – see details at <http://www.hra.nhs.uk/hra-training/>

14/SW/1008	Please quote this number on all correspondence
-------------------	---

With the Committee's best wishes for the success of this project.

Yours sincerely



pp
Dr Margrid Schindler
Vice Chair

Email: nrescommittee.southwest-bristol@nhs.net

Enclosures: "After ethical review – guidance for researchers" [\[SL-AR2\]](#)

Copy to: Gail Seymour, University of Exeter
Katharine Wale, University Hospitals Bristol NHS Foundation Trust



Health Research Authority

NRES Committee South West - Central Bristol

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05 January 2015

Mr Steven Mahan
School of Psychology
Washington Singer Building
University of Exeter
Exeter, Devon
EX4 4QG

Dear Mr Mahan

Study title: Content-Free Cueing and 'Remembering Goals' Training:
The Rehabilitation of Prospective Memory Deficits
Following Paediatric Acquired Brain Injury
REC reference: 14/SW/1008
Amendment number: 2
Amendment date: 22 December 2014
IRAS project ID: 150366

The above amendment was reviewed the Sub-Committee in correspondence.

Ethical opinion

The members of the Committee taking part in the review gave a favourable ethical opinion of the amendment on the basis described in the notice of amendment form and supporting documentation.

The amendment approved the following:

- 1) Change to the age group from 12-17 to 10-18 years old.
- 2) Removing epilepsy from the exclusion criteria.
- 3) Amendments to supporting documents and the study title to reflect these changes.

Approved documents

The documents reviewed and approved at the meeting were:

Document	Version	Date
GP/consultant information sheets or letters [Letter to GP]	2	14 December 2014

Notice of Substantial Amendment (non-CTIMP) [Steven Mahan Notice of Substantial Amendment 2 dated 22.12.2014]	2	22 December 2014
Other [Assent Form (10-15)]	2	14 December 2014
Participant consent form [Participant Consent Form (16-18)]	2	14 December 2014
Participant consent form [Parental Consent Form]	2	14 December 2014
Participant consent form [Parent Consent to Contact Form]	2	14 December 2014
Participant consent form [Consent to Contact (Participant)]	2	14 December 2014
Participant Information sheet (PIS) [Participant Information Sheet (16-18 years)]	3	14 December 2014
Participant Information sheet (PIS) [Participant Information Sheet (10-15 years)]	3	14 December 2014
Participant Information sheet (PIS) [Parent Information Sheet]	3	14 December 2014

Membership of the Committee

The members of the Committee who took part in the review are listed on the attached sheet.

R&D approval

All Investigators and research collaborators in the NHS should notify the R&D office for the relevant NHS care organisation of this amendment and check whether it affects R&D approval of the research.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

We are pleased to welcome researchers and R & D staff at our NRES committee members' training days – see details at <http://www.hra.nhs.uk/hra-training/>

14/SW1008: Please quote this number on all correspondence
--

Yours sincerely



pp

Dr Pamela Cairns (Chair)
Chair

E-mail: nrescommittee.southwest-bristol@nhs.net

Enclosures: *List of names and professions of members who took part in the review*

Copy to: *Katharine Wale, University Hospitals Bristol NHS Foundation Trust
Gail Seymour, University of Exeter*

Research Ethics Committee established by the Health Research Authority


Ethics Approval System

To: Mahan, Steve

Reply-To: D.M.Salway@exeter.ac.uk

Your application for ethical approval (2015/639) has been accepted

9 September 2014 09:49

Major research project 



Ethical Approval system



Your application (2015/639) entitled Prospective Memory in Children with an Acquired Brain Injury has been accepted

Please visit <http://www.exeter.ac.uk/staff/ethicalapproval/>

Please click on the link above and select the relevant application from the list.

D. Risk Protocol

<p>As all of the participants in the research were under the age of 16, informed and voluntary written consent was obtained from the participants' parents, and written assent was obtained from all of the participants. All parents were given information sheets detailing the purpose of the research, and the nature and duration of the study.</p>
<p>Children and adolescents received a specially designed and age appropriate information sheet outlining the study aims and tasks that they would be asked to complete. Information was presented to children and adolescents in an appropriate way to facilitate comprehension and retention of information, and to facilitate the provision of informed consent.</p>
<p>Participants and their parents were provided with copies of the information sheets during the recruitment procedure, and they had least 24-hours to consider the study before being contacted by the researcher to discuss the study and to answer any questions.</p>
<p>Verbal consent was established before an initial appointment was made. The researcher then met with the child and their parent(s) to review the information sheet and answer questions before written consent/assent is obtained.</p>
<p>It was made clear to each participant that they had the right to withdraw at any time without giving reason, even if their parent(s) had consented for them to participate. When appropriate, both the participants and their parent(s) were assured that withdrawal from the research would not prejudice any future treatment they might receive.</p>
<p>Written consent was obtained from or on behalf of all participants.</p>
<p>As the data collection involved time commitment from each participant and their parent(s), participants were made aware of what was involved at the start the study and they were reminded that they were free to withdraw at any time. Training times were scheduled within the constraints of participants' daily lives.</p>
<p>Steps were taken to ensure that participants did not feel disappointed with their performance on tasks. All measures and tasks were administered with minimal risk of distress to the participant.</p>
<p>The researcher explained prior to neuropsychological assessment administration that if an individual did not wish to continue with the study at any point then they have the option of ceasing the assessment without any adverse ramifications.</p>

During assessment, the participants were assured that “nobody gets every question right” and standardised discontinuation criteria were applied. If a participant had become distressed or upset during an assessment, then the session would have been stopped, the reasons for the distress explored and appropriate action would have been taken. This did not happen in the present study. Participants were offered regular breaks throughout the assessments to ensure that they do not become over-fatigued.

Plans were in place that if the researcher became concerned about the level of distress or risk then the individual would be informed that this will need to be discussed with either the researcher’s supervisor or the field collaborator, both of which were qualified Clinical Psychologists. The supervisor or field collaborator would then have conducted a more detailed risk assessment (either on the telephone or a home visit) with the participant (or their parent) and, if appropriate, would advise the participant to contact their GP or a health professional already involved in their care. If significant and urgent risk issues were identified then the researcher’s supervisors would have informed the necessary agencies as appropriate. The need to implement this plan did not arise during the present study.

As the study involved the use of a mobile phone to complete the PM task, parents of participants were asked to oversee this for potential misuse. The research also involved home visits. To minimise risk, the appropriate NHS Trust lone worker policy was followed. The researcher informed others in the research team of the location and time of appointments, and arrangements were reported back on safe return.

Data was coded anonymously and stored in accordance with the Data Protection Act (1998). Participant contact details and paper data were then stored separately in a locked filing cabinet located at Bristol Royal Hospital for Children (except for those who consented to having their contact details stored on the secure electronic register). Electronic data were stored on a password-protected computer, and any transfer of occurred with an encrypted memory stick. Only the researchers involved in the study had access to participants’ personal information, and no legal or ethical obligations arose related to the welfare and safety of the child that meant confidentiality had to be breached.

E. Clinical Interview Proforma

Prospective Memory in Children and Adolescents
Researchers: Mr Steven Mahan and Dr Anna Adlam

CLINICAL INTERVIEW PROFORMA

Participant Study ID:
Assessment Date:.....
Date of Informed Consent:.....

Name:

DoB:

Address:

Email address:

Mobile telephone no:

Backup tel. no:

Ethnicity:

Language spoken:

GP Details:

School details:

Years of Education:
Highest Qualification:

Details of any additional support at school:

Schooling history:

Living situation (e.g. alone or with famiy):

Parent/significant other (Name and relationship):
Tel nos.:
Email address:
Contact address (if different):

Support (who and how much):

Nature of Neurological Condition:

Aetiology?
Date of onset?
Details (type/location/severity):

Hospital:

Any rehab?

Any pre-injury physical or developmental issues? Other health problems?

Preferred testing location:

Leisure/Hobbies/Interests

Usual method of knowing the time:
Watch? Mob phone clock? None?
Prefers digital or analogue?

Method of planning, organising, etc?
Any strategies used?

Typical daily routine? (include any regular meetings, school clubs, after school activity?)

Mobile phone details:

Own phone? Y/N

Type?

Network?

PAYG/Contract? Free mins?

Does it vibrate on silent: Y/N

Normal usage? Frequent/ sometimes/ occasionally/ never at present

Phone charged regularly: Y/N

Phone turned on regularly? Y/N

Use text messaging? Y/N

Stop and read immediately? Y/N

Skype:

Address:

Webcam? Y/N

Microphone? Y/N

F. Psychometric Properties of Neurocognitive Assessment

General intellectual function. The Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV; Weschler, 2003) was employed to provide an estimate of each participant’s general intellectual function. Seven subtests were employed to deliver a pro-rated Full Scale IQ (FSIQ) score. These subtests included: Similarities (SI) and Vocabulary (VC), which yield a Verbal Comprehension Index (VCI) to provide an estimate of the participants’ verbal comprehension abilities; Block Design (BD) and Matrix Reasoning (MR), which yield a Perceptual Reasoning Index (PRI) to provide an estimate of the participants’ visuo-spatial functioning abilities; Digit-Span, which provides an estimate of the participants’ working memory abilities, and; Symbol Search (SS) and Coding (Cd), which yield a Processing Speed Index (PSI), which provides an estimate of the participants’ processing speed abilities. To yield the VCI scores, in accordance with Table A.7 in the WISC-IV Administration manual (Wechsler, 2003), the subtests SI and VC were averaged and multiplied by three to produce a sum of SS (SSS). Similarly, to yield the PRI scores, the subtests BD and MR were averaged and multiplied by three to produce a SSS. To calculate pro-rated FSIQ scores, the seven subtests’ SS were averaged and multiplied by 10, which is the total number of FSIQ subtests in the WISC-IV (Weschler, 2003).

The WISC-IV has high internal consistency ($r = .97$) and test-retest stability ($r = .89$). Furthermore, all the subtests have adequate reliability and validity (for example, SI and BD have reliability coefficients of .86; Sattler & Dumont, 2004).

Verbal memory. To assess each participant’s verbal memory abilities, the Stories subtest from the Children’s Memory Scale (CMS; Cohen, 1997) was utilised. Participants were asked to remember two short stories and recall both immediately and after a delay of approximately twenty minutes, and participants were scored on the number of correctly recalled story units.

The CMS has good internal consistency (coefficients between .88 and .93) and the stories subtest has good split-half reliability (average coefficients of .78) and good inter-rater reliability (average coefficients of .99; Cohen, 1997).

Attention. To assess sustained attention and response inhibition, the Walk, Don't Walk subtest from the Test of Everyday Attention for Children (TEA-CH; Manly, Robertson, Anderson, & Nimmo-Smith, 1999) was employed. Participants were required to discriminate and inhibit their responses to target sounds across a seven-minute test. This subtest has good test-retest reliability ($r = .73$; Manly et al., 2001).

Cognitive Flexibility. To assess each participants' cognitive flexibility, three conditions from the Trail Making Test (TMT) were administered from the Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001). These conditions were: Condition Two – Number Sequencing, where participants were required to draw a sequential line through the numbers from one to 16 as quickly as possible; Condition Three – Letter Sequencing, where participants were required to draw a sequential line through the letters A to P, as quickly as possible, and; Condition Four – Number-Letter Switching, where participants were required to draw a sequential line whilst switching between ascending numbers and letters (e.g., 1 to A to 2 to B, and so on), as quickly as possible until they reach the letter P.

Executive function and prospective memory. To assess each participant's executive functioning abilities, the Six Part test from the Behavioural Assessment of the Dysexecutive Syndrome for Children (BADS-C; Emslie et al., 2003) was employed. This test specifically assessed each participants' ability to plan and organise themselves whilst having to complete multiple tasks. Arguably, this mirrors the cognitive demands of PM and thus was used as a measure of PM also. Participants were required to attempt several tasks over a five-minute period whilst remembering some task rules.

The Six Part test has good inter-rater reliability ($r = .92$) and Baron (2007) argues that it has good ecological validity.

Behavioural questionnaires. To assess participants' and their parents' subjective experience of their PM deficits in the participants' everyday lives, the PRMQ self- and informant-versions were employed in the study (Smith, Della Sala, Logie, & Maylor; 2000). Both the self and informant versions of the PRMQ are 16-item questionnaires with eight items surrounding their experience of PM difficulties and eight items surrounding their experience of retrospective memory difficulties. The self-version questionnaire examines the participants' experience, whereas the informant-version examines the parents' observations of their child's experience of these difficulties. The PRMQ has not been fully validated in children and adolescents, with standardisation only available for ages 17 to 94 years old, and thus the results of the PRMQ when applied to children and adolescents must be treated with caution. Previous studies have, however, employed this measure in a paediatric population (Kliegel & Theodor, 2007; Rous, 2011) and the items are generally considered to be age applicable for a paediatric population (Rous, 2011).

To assess the experience of parents to cope with their child's PM difficulties, the Family Burden of Injury Interview (FBII) was employed (Burgess, 1999).

G. Intervention Feedback Form

PARTICIPANT FEEDBACK FORM

Prospective Memory in Children and Adolescents with an Acquired Brain Injury

Researchers: Mr Steven Mahan and Dr Anna Adlam

Participant Name:

Date:

QUESTION	RATING: 0 = Not at all 10 = Very/A lot
Routine: How easy was it to remember to send text messages as part of your daily routine?	
How easy was it to remember to do your goals as part of your daily routine?	
Taking time to think: How adequately did you take time out from what you were doing to think about the text message task during the day?	
How adequately did you take time out from what you were doing to think about your goals during the day?	
Autopilot: How much do you think you were acting on autopilot during the study?	
Achievement: How much of what you intended to do did you actually achieve over the study?	
Intentions: How much did the training help you carry out your goals and other intentions?	
Effort: How hard did you try to remember to send text messages?	
Motivation: How motivated were you to send text messages?	
How motivated were you to do your goals?	
Importance: How important was it to you to remember to send the text messages?	
How important was it to you to remember to do your goals?	
Difference: How much difference did the "STOP" strategy make to you?	

H. Information Sheets

Neurological Condition: PARENT/GUARDIAN INFORMATION SHEET

Prospective Memory in Children and Adolescents with a Brain Injury and/or Epilepsy Researchers: Mr Steven Mahan and Dr Anna Adlam

We would like to invite your child to take part in a research study, which is looking at a way of helping young people with a brain injury and/or epilepsy who find it hard to remember to do some things. The research would involve your child being taught a way of trying to help them with remembering to do things, receiving and sending some text messages, and setting some daily goals, which they will try and achieve. It is important to note that the research will not interfere with (or take part during) your child's school time.

Before you decide to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please do not hesitate to contact us if there is anything that is not clear or if you would like more information (contact details can be found at the bottom of this sheet). You do not have to decide straight away if you would like your child to take part in this research. Thank you for reading this.

What is this study about?

'Prospective Memory' is when someone has to remember to pass on a message to a friend, or remember to post a card for a friend's birthday, for example. It is simply the ability to remember to do something at a later time. Lots of people say they find it hard to remember to do things at a later time, but a lot of research suggests that many people who have neurological differences, such as from a brain injury or epilepsy often struggle with this quite a bit. A brain injury can be caused by many different things, such as from a head injury in a car accident, or from an illness, like a stroke or a brain tumour. Epilepsy is a condition that affects the brain and causes repeated seizures, which some people refer to as "fits".

We are looking at a way of trying to help children and adolescents with a brain injury and/or epilepsy who also find it hard to plan, organise, and remember to do things at a later time. We are looking at whether sending people text messages that read "STOP" (which reminds them to Stop, Think, Organise, and Plan) can help them to remember to carry out something they had planned to do.

Why do you want my child to take part?

We are hoping to recruit around 10 children and adolescents between the ages of 10 and 18 years old, who have experienced a brain injury and/or epilepsy and who also have difficulties with remembering to do things in the future. We would like to invite your child to take part because of his or her age and history of a brain injury. We will check if your child has memory difficulties (by completing a brief screening assessment) before asking him or her to take part in the whole study.

Does my child have to take part?

No, it is entirely up to you and your child whether you wish to take part. If you or your child decide not to take part we will respect your decision, and it will not affect any future healthcare that your child may receive. If you and your child do decide to take part, we will ask you to first sign a consent form and your child to give their permission before s/he begins the study. We will give you a copy of the forms and this information sheet to keep. If at any time you or your child decide that you no longer wish to take part, they can stop taking part in the research without giving any reason or explanation. If this happens, any future care that your child may need will not be affected in any way. We will also destroy any data we have collected from your child so far and it will not be used in the research.

What will happen if my child does take part?

If you and your child give permission to take part, we would ask that you are involved in the study for approximately 4 weeks. Although this may seem like quite a lot of work, the time involved each day during the study may typically be quite small, approximately 20 minutes. You and your child will not need to take part in the study at weekends and all appointments times will be at a time that is convenient for you and your child. All appointments will either be at your home or at the Bristol Royal Hospital for Children. These meetings should last no longer than an hour.

First, we will arrange a convenient time to meet with you and your child to explain the study in detail. We will then ask you and your child to complete a form to indicate that you are willing to participate in the study. During this session we will ask your child to complete a brief assessment of memory and some other brief measures. This appointment will take about 1 hour in total at your home or at the Bristol Royal Hospital for Children. If we find that your child does not have difficulties in remembering to do things in the future, then we will not continue with the study. If this happens, then we will let you know about other research studies that we are running in case these are also of interest to you.

If we find that your child does have difficulties in remembering to do some things, then we will arrange to meet with you and your child again, within two weeks, to complete further pen and paper assessments of general thinking, memory, and attention abilities, and some questionnaires. This will take approximately 1 hour.

We will then ask your child to remember to send a text message to us, at three set times per working day. This will not take place during school time, and the times that they have to send text messages will be set at a time that suits you and your child. We will also ask your child to set three goals each day, of things that they would like to remember to do. This could be anything, such as remembering to feed a pet, for example. However, these goals would be things that you would know if they have achieved or not. We will then ask both you and your child to rate how successful they have been in remembering their goals. If you are happy, we will call each day to collect the goal ratings, and to help set new goals for the following day if that would be helpful. Please note that if your child is doing well at these tasks after twelve working days then they will not need to take part in the study any further and they will be withdrawn from the study.

After either six or twelve working days (depending on how your child has done so far), we will give your child some training about things they can do to help them to remember to do things. After this, we will send reminder “STOP” text messages on some days. This is to remind them to use the strategy we will have taught them during the training session, to prompt them to send the text messages at set times, and to review their own goals. This will happen for twelve working days in total. After six working days (half-way through the study), we will repeat the training with them, to remind them what the “STOP” texts mean. At the end of the study, we will ask you and your child what you thought of the training and text messages. All research costs will be reimbursed to you in full, such as any travel costs or phone credit.

Are there any risks to my child if they take part?

The study involves completing paper and pencil assessments, and two training sessions to teach them a way of remembering to do things. We are also asking you and your child to commit to the study for approximately 4 weeks in total. All text times will be set by you and your child, at a time that is convenient.

At the start of the study, we shall ask your child to complete some tests that will assess memory and other thinking skills. These tests are designed especially for children and adolescents, and are quite commonly used without causing any upset. However, testing will be stopped immediately if your child becomes tired or stressed in any way. To minimise the risk of becoming tired, the assessments can be conducted over a couple of shorter sessions, if this is preferred, and regular breaks for a rest will be included. In the unlikely event that your child becomes stressed or upset in any way, the assessments will be stopped immediately and reasons for their distress will be explored.

What are the potential benefits?

By participating in this study, you will be contributing to research investigating memory difficulties in children who have survived a brain injury and/or who have epilepsy. You will also be helping us to work out how good our memory training programme is for children and adolescents who have survived a brain injury and/or who have epilepsy. As a small token of our appreciation for taking part, your child will be given an age-appropriate trinket at the end of the study (such as stickers, pens, or a keyring).

Will my child’s information be kept confidential?

All information will be made anonymous, and confidentiality and security of all data will be maintained at all times. This means we will not write your name or your child’s name or address on any questionnaires or score sheets. Written data will be kept in a secure location (a locked filing cabinet at the Bristol Royal Hospital for Children). No identifying information (including names) will accompany the data; instead, a number will be used to identify each young person to protect their anonymity.

When the study is finished all information collected from questionnaires and other study measures will be stored in a locked drawer, at the University of Exeter, for a minimum of 5 years and up to a maximum of 10 years. It will then be destroyed. If you agree to have your contact details added on to the Volunteer Register, we will contact you before 5 years elapses to ask if you wish to remain on the Register. We would also like to let your child's GP know that s/he is taking part in the research. This is in case you would like to discuss the study with their GP. However, no results will be shared with their GP without your permission. The only time we would disclose any of the information that you or your child has given us, would be if criminal or other potentially harmful behaviour was made known. We would, however, aim to discuss this with you first.

What will happen to the results of the study?

The results will be submitted to peer-reviewed journals and presented at conferences and meetings. Yours and your child's names will not be included on any research outputs, and all data will be presented anonymously.

If you would like to know how your child performed on their measures of general thinking, memory, and attention abilities, then we can give you a brief report summarising this. This report will be written under the supervision of Dr Anna Adlam (Clinical Psychologist), and you can give a copy of the report to your child's school, GP, or other health professionals working with your child. We can also give you an overall summary of the study findings for your information.

Who is organising the research?

The University of Exeter is running and funding the study, supported by the Neuropsychology team at the Bristol Royal Hospital for Children. Please note that the researchers are not being paid to conduct this research.

Who has reviewed the study?

In order to ensure that it is safe and appropriate for those taking part, all research is reviewed by a research panel. This study has been reviewed and approved by the University of Exeter Ethics Committee and the South West – Bristol Research Committee.

Are there more research studies my child could engage in?

The Centre for Clinical Neuropsychology (CCNR) is currently building a research participant register so that people who are interested can be contacted directly about new research studies. If you and your child would like to take part in further studies of this kind then we can indeed add you to the register. Your contact details would be stored, in addition to your child's name, date of birth, and sex, on a secure volunteer panel, which is managed by Dr. Anna Adlam. This information will be maintained in accordance with the Data Protection Act (1998) and will not be shared with anyone outside of the University of Exeter. You will only be sent details of studies that have received full ethical approval from the University of Exeter's Research Committee. The panel will be reviewed every 5 years to offer you the chance to opt out, should you wish to. To join the volunteer register, please contact the research team via ccnr@exeter.ac.uk and indicate 'Volunteer Panel' in the subject heading.

What if there is a problem?

If you have any questions or experience any difficulties then please contact a member of the research team. If you would like to make a complaint, please contact Dr Anna Adlam (contact details are below).

What to do if you would like to take part?

Enclosed is a consent form to share your contact details with the research team. This is for you to complete if you would like to take part in the study. You need to fill in the form, initial all the boxes, sign and send it back to us using the Freepost envelope provided or give it to the clinician who alerted you about our study. We will then telephone you to arrange the first meeting. We can only contact you if you return the 'consent to share your contact details' form to us.

Further information and contact details

For further information about the project please contact Mr Steven Mahan (sm519@exeter.ac.uk) or Dr Anna Adlam (A.R.Adlam@exeter.ac.uk) at the University of Exeter, Centre for Clinical Neuropsychology Research (CCNR), School Of Psychology, College of Life and Environment Sciences, Exeter, EX4 4QG. Telephone: **01392 722209** (office telephone). We will be happy to answer any questions that you might have.

PARTICIPANT INFORMATION SHEET (10-15 years)

Prospective Memory in Children and Adolescents with a Brain Injury and/or Epilepsy

Researchers: Mr Steven Mahan and Dr Anna Adlam

We would like to invite you to take part in our research study. The research would involve you being taught a way of trying to help you with remembering to do things, receiving and sending some text messages, and setting some goals, which you will try to do each day. The research will not take part during your school time.

Before you decide to take part, we would like to tell you why the research is being done and what we will ask you to do. Please read the information carefully or ask someone to read it to you so you can decide if you want to take part or not. You do not have to decide straight away if you would like to take part in this research. You can talk about it with your family and friends or doctor if you want to. Feel free to ask us if there is anything that you do not understand.



What is this study about?

‘Prospective Memory’ is when someone has to remember to pass on a message to a friend, or remember to post a card for a friend’s birthday, for example. It is simply when we remember to do something at a later time. We are looking at a way of trying to help children with brain injuries and/or epilepsy who also struggle with how they plan, organise, and remember to do things at a later time. We are looking at whether sending people text messages that read “STOP” (which reminds them to Stop, Think, Organise, and Plan) can help them to remember to carry out something they had planned to do.

Why do you want me to take part?

We would like children and teenagers between 10 and 18 years old to take part, who have had a brain injury and/or epilepsy and have difficulties with remembering to do things at a later time. We would like to invite you to take part because of your age and because you have a brain injury and/or epilepsy. We will check if you struggle with remembering to do things in the future (by completing a couple of pen and paper tests, which are a bit like a quiz) before asking you to take part in the whole study.

Do I have to take part?

No, it is entirely up to you and your parent(s)/guardian(s) if you wish to take part or not. You and your parent(s)/guardian(s) will be asked to sign a form to say that you are happy to take part. However, you can still change your mind and stop taking part in the study at any time, without telling us why if you don’t want to.



What will happen if I do take part?

If you would like to take part, we would ask that you are involved in the study for around 4 weeks. Although this may seem like quite a lot of work, you would probably only be doing things for the research for about 20 minutes each day. You will not need to take part in the study at weekends.

First, we will arrange a good time to meet with you and your parent(s)/guardian(s) to explain the study. During this session, we will ask you to complete a couple of tests to see how your memory is and some other brief measures. Some are a bit like doing a quiz, and some are like doing a puzzle. Your parents can be there for this if you would like them to. If we find that you do not have difficulties in remembering to do things in the future, then we will not ask you to do anything else for this study.

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If we find that you do have some memory difficulties, then we will meet with you again to complete a few more pen and paper tasks, which look at your 'thinking skills', such as your memory and attention, and some questionnaires (again, these are like doing a quiz or a puzzle).



We will then ask you to remember to send a text message to us, at three set times each day (but not at weekends). This will not take place during school time, and the times that you have to send text messages will be set at a time that suits you. We will also ask you to set three goals each day, of things that you would like to remember to do. This could be anything, such as remembering to feed a pet, for example. However, these goals would be things that your parents would know if you have done or not. We will then ask you and your parents to rate how much of your goal you have remembered to do. If you are doing well on these tasks after twelve days, you will not need to help us with the study any further and we will withdraw you from the study.

After either six or twelve days (depending on how you have done so far), we will give you some training about things you can do to help you to remember to do things. After this, we will send reminder "STOP" text messages on some days. These "STOP" texts are to remind you to send the text messages at set times, and to think about how you're doing on your goals. This will happen for twelve days all together. Half-way through the study, we will repeat the training with you to remind you what the "STOP" texts mean.

What is good about the study?

By helping us with this study, you are helping us to learn more about memory in children who have a brain injury and/or epilepsy. This will hopefully help us learn new ways of helping these children. To say thank you for taking part, at the end of the study we will give you a small gift, such as stickers, pens, or a keyring, for example.

What is not so good, about the study?

In this study we will ask you to do some paper and pencil tasks, and two training sessions to teach you a way of remembering to do things. One of the not so good things about taking part is that you might feel a bit tired when doing some of these tasks. To help you feel less tired, we will have plenty of breaks for a rest. If you feel upset or stressed when doing these tasks, we can stop and we will ask you if you want to talk about it. We can either carry on after a break, or we can stop completely. It will be up to you.

Who will know what I have said?

Only the researchers will know how you have done on the tasks and they will not be allowed to tell anyone else how you did without your parent(s)/guardian(s) permission. The answers that you give will be kept safely locked away in a filing cabinet at the University. Your name will not be written on any of your answer sheets. If your parent(s)/guardian(s) want us to, then we might tell your doctor that you have taken part in the study. If you tell us something that worries us, then we might have to share it with someone else. We will let you know if we plan to do this.

The study findings might appear in magazines for medical doctors and scientists to read. Your name will not be included. If you and your parent(s)/guardian(s) want, then we will write you a letter to tell you how you did on the tasks.

What happens at the end of the study?

When the study is finished, the research team will write about the results in research magazines, and will present the results at research meetings. Nothing that we write or talk about will have your name in it. At the end of the research, we can also send you a short letter to tell you what we found overall.

Is the research safe and who has checked it?

This research has been looked at by a separate group of people called a Research Ethics Committee. The group of people have decided that it is safe for you to take part in.

What do I do if I want to take part?

Your parent(s)/guardian(s) have also received information about this study. If you would like to take part, let me know. If they are also happy for you to take part, let them know and, if they are also happy for you to take part, they will contact us for you.

Thank you for reading this information sheet!



PARTICIPANT INFORMATION SHEET (16-18 years)

Prospective Memory in Children and Adolescents with a Brain Injury and/or Epilepsy

Researchers: Mr Steven Mahan and Dr Anna Adlam

We would like to invite you to take part in a research study, which is looking at a way of helping young people with a brain injury and/or epilepsy who find it hard to remember to do some things. The research would involve you being taught a way of trying to help you with remembering to do things, receiving and sending some text messages, and setting some daily goals, which you will try and achieve. The research will not interfere with (or take part during) your education or work time.

Before you decide to take part, it is important for you to understand why the research is being done and what you would have to do if you took part. Please take time to read the following information carefully and discuss it with your friends, family, or GP if you wish. Please do not hesitate to contact us if there is anything that is not clear or if you would like more information (contact details can be found at the bottom of this sheet). You do not have to decide straight away if you would like to take part in this research. Thank you for reading this.

What is this study about?

‘Prospective Memory’ is when someone has to remember to pass on a message to a friend, or remember to post a card for a friend’s birthday, for example. It is simply when we remember to do something at a later time. Lots of people say they find it hard to remember to do things at a later time, but a lot of research suggests that many people who have neurological differences, such as from a brain injury or epilepsy, often struggle with this quite a bit. A brain injury can be caused by many different things, such as from a head injury in a car accident, or from an illness, like a stroke or a brain tumour. Epilepsy is a condition that affects the brain and causes repeated seizures, which some people refer to as “fits”.

We are looking at a way of trying to help children and adolescents with a brain injury and/or epilepsy who also struggle with how they plan, organise, and remember to do things at a later time. We are looking at whether sending people text messages that read “STOP” (which reminds them to Stop, Think, Organise, and Plan) can help them to remember to carry out something they had planned to do.

Why do you want me to take part?

We would like around 10 teenagers with a brain injury and/or epilepsy between the ages of 10 and 18 years old to take part, who have had a brain injury and/or epilepsy and who also have trouble with remembering to do things in the future. We would like to invite you to take part because of your age and because you have a brain injury and/or epilepsy. We will check if you struggle with remembering to do things in the future (by doing a brief screening assessment) before asking you to take part in the whole study.

Do I have to take part?

No, it is entirely up to you if you wish to take part or not. If you do not want to take part we will respect your decision, and it will not affect any future healthcare that you may receive. If you do want to take part, we will ask you to first sign a consent form before you begin the study, to show that you have given your permission to be in the study. We will give you a copy of the forms and this information sheet to keep. If at any time you decide that you no longer want to take part, you can stop taking part in the research without giving any reason or explanation. If this happens, any future care that you may need will not be affected in any way. We will also destroy any data we have collected from you so far and it will not be used in the research.

What will happen if I do take part?

If you give your permission to take part, we would ask that you are involved in the study for around 4 weeks. Although this may seem like quite a lot of work, the time involved each day during the study would be quite small, roughly around 20 minutes. You will not need to take part in the study at weekends and all appointments times will be at a time that suits you. All appointments will either be at your home or at the Bristol Royal Hospital for Children. These meetings should last no longer than an hour.

First, we will arrange a time that suits you to meet with you to explain the study in detail. We will then ask you to complete a form to show that you are willing to be in the study. During this session we will ask you to complete a brief assessment of memory and some other brief measures. This appointment

Trainee Number: 12/01017

will take about 1 hour in total at your home or at the Bristol Royal Hospital for Children. Your parents can be there for this if you would like them to. If we find that you do not have memory difficulties, then we will not continue with the study. If this happens, then we will let you know about other research studies that we are running in case these are also of interest to you.

If we find that you do have some memory difficulties, then we will arrange to meet with you again, within two weeks, to complete further pen and paper assessments of your 'thinking skills', such as your memory and attention, and some questionnaires. This will take approximately 1 hour.

We will then ask you to remember to send a text message to us, at three set times per working day. This will not take place during school or work time, and the times that you have to send text messages will be set at a time that suits you. We will also ask you to set three goals each day, of things that you would like to remember to do. This could be anything, such as remembering to feed a pet, for example. However, these goals would be things that your parent(s)/guardian(s) would know if you have achieved or not. We will then ask you and your parent(s)/guardian(s) to rate how successful you have been in remembering your goals. If you are happy, we will call each day to collect the goal ratings, and to help set new goals for the following day if that would be helpful. Please note that if you are doing well at these tasks after twelve working days then you will not need to take part in the study any further and you will be withdrawn from the study.

After either six or twelve working days (depending on how you have done so far), we will give you some training about things you can do to help you to remember to do things. After this, we will send reminder "STOP" text messages on some days. This is to remind you to use the strategy we will have taught you during the training session, to remind you to send the text messages at set times, and to review your own goals. This will happen for twelve working days in total. After six working days (half-way through the study), we will repeat the training with you to remind you what the "STOP" texts mean.

At the end of the study, we will ask you what you thought of the training and text messages. We will cover all research costs for you (such as any travel costs or phone credit). You will not have to pay for anything.

Are there any risks to me if I take part?

The study involves completing paper and pencil assessments, and two training sessions to teach you a way of remembering to do things. We are also asking you to take part in the study for around 4 weeks in total. You will be able to set the texts times at a time that suits you.

At the start of the study, we shall ask you to complete some tests that will assess memory and other thinking skills. These tests are designed especially for children and adolescents, and these tests do not normally upset people. However, we will stop the testing straight away if you become tired or stressed in any way. These tests can be carried out over a couple of shorter sessions, if this is preferred, and regular breaks for a rest will be included. If you do become upset in any way, we can stop straight away and we will try and find out why you became upset.

What are the potential benefits?

By taking part in this study, you will be helping with research that looks at memory in children and adolescents who have survived a brain injury and/or who have epilepsy. You will also be helping us to work out how good our memory training programme is for children and adolescents who have survived a brain injury and/or who have epilepsy. As a small token of our thanks, we will give you a trinket of your choice for taking part (such as pens or a key ring, for example).

Who will know what I have said?

All information will be made anonymous, and confidentiality and security of all data will be maintained at all times. This means we will not write your name or address on any questionnaires or score sheets. Written data will be kept in a secure location (a locked filing cabinet at the Bristol Royal Hospital for Children). No identifying information (including names) will accompany the data; instead, a number will be used to identify each young person to protect their anonymity.

When the study is finished all information collected from questionnaires and other study measures will be stored in a locked drawer, at the University of Exeter, for a minimum of 5 years and up to a maximum of 10 years. It will then be destroyed. If you agree to have your contact details added on to the Volunteer Register, we will contact you before 5 years elapses to ask if you wish to remain on the Register. We

would also like to let your GP know that you are taking part in the research. This is in case you would like to discuss the study with them. However, no results will be shared with your GP without your permission. The only time we would disclose any of the information that you have given us, would be if we were worried about your (or others') safety. We would, however, aim to discuss this with you first.

What will happen once I have taken part in the study?

The results will be submitted to peer-reviewed journals and presented at conferences and meetings, but this will be done anonymously; no one will know it was your results.

If you would like to know how you did on the standardised measures of 'thinking skills' then we can give you a brief report summarising this. This report will be written under the supervision of Dr Anna Adlam (Clinical Psychologist), and you can give a copy of the report to your school or work, GP, or other health professionals working with you if you would like to. We can also give you an overall summary of the study findings for your information.

Who is organising the research?

The University of Exeter is running and funding the study, supported by the Neuropsychology team at the Bristol Royal Hospital for Children. Please note that the researchers are not being paid to conduct this research.

Who has reviewed the study?

In order to ensure that it is safe and appropriate for those taking part, all research is reviewed by a research panel. This study has been reviewed and approved by the University of Exeter Ethics Committee and the South West – Bristol Research Committee.

Are there more research studies that I could take part in?

The Centre for Clinical Neuropsychology (CCNR) is currently building a research participant register so that people who are interested can be contacted directly about new research studies. If you would like to take part in further studies of this kind then we can add you to the register. Your contact details would be stored, along with your name, date of birth, and sex on a secure volunteer panel, which is managed by Dr. Anna Adlam. This information will be maintained in accordance with the Data Protection Act (1998) and will not be shared with anyone outside of the University of Exeter. You will only be sent details of studies that have received full ethical approval from the University of Exeter's Research Committee. The panel will be reviewed every 5 years to offer you the chance to opt out, should you wish to. To join the volunteer register, please contact the research team via ccnr@exeter.ac.uk and indicate 'Volunteer Panel' in the subject heading.

What if there is a problem?

If you have any questions or experience any difficulties then please contact a member of the research team. If you would like to make a complaint, please contact Dr Anna Adlam (contact details are below).

What to do if you would like to take part?

Enclosed is a consent form to share contact details for you to complete if you would like to take part in the study. You need to fill in the form, initial all the boxes, sign and send it back to us using the Freepost envelope provided or give it to the clinician who told you about our study. We will then telephone you to arrange the first meeting. We can only contact you if you return the 'consent to share your contact details' form to us.

Further information and contact details

For further information about the project please contact Mr Steven Mahan (sm519@exeter.ac.uk) or Dr Anna Adlam (A.R.Adlam@exeter.ac.uk) at the University of Exeter, Centre for Clinical Neuropsychology Research (CCNR), School Of Psychology, College of Life and Environment Sciences, Exeter, EX4 4QG. Telephone: **01392 722209** (office telephone). We will be happy to answer any questions that you might have.

Thank you for reading this information sheet

PM difficulties with unknown neurological aetiology:

PARENT/GUARDIAN INFORMATION SHEET

Prospective Memory in Children and Adolescents

Researchers: Mr Steven Mahan and Dr Anna Adlam

We would like to invite your child to take part in a research study, which is looking at a way of helping young people who find it hard to remember to do some things. The research would involve your child being taught a way of trying to help them with remembering to do things, receiving and sending some text messages, and setting some daily goals, which they will try and achieve. It is important to note that the research will not interfere with (or take part during) your child's school time.

Before you decide to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please do not hesitate to contact us if there is anything that is not clear or if you would like more information (contact details can be found at the bottom of this sheet). You do not have to decide straight away if you would like your child to take part in this research. Thank you for reading this.

What is this study about?

'Prospective Memory' is when someone has to remember to pass on a message to a friend, or remember to post a card for a friend's birthday, for example. It is simply the ability to remember to do something at a later time. Lots of people say they find it hard to remember to do things at a later time, but some people struggle with this quite a bit.

We are looking at a way of trying to help children and adolescents who also find it hard to plan, organise, and remember to do things at a later time. We are looking at whether sending people text messages that read "STOP" (which reminds them to Stop, Think, Organise, and Plan) can help them to remember to carry out something they had planned to do.

Why do you want my child to take part?

We are hoping to recruit around 10 children and adolescents between the ages of 10 and 18 years, who have difficulties with remembering to do things in the future. If you and your child are interested in taking part, we will check if your child has memory difficulties (by completing a brief screening assessment) before asking him or her to take part in the whole study.

Does my child have to take part?

No, it is entirely up to you and your child whether you wish to take part. If you or your child decide not to take part we will respect your decision. If you and your child do decide to take part, we will ask you to first sign a consent form and your child to give their permission before s/he begins the study. We will give you a copy of the forms and this information sheet to keep. If at any time you or your child decide that you no longer wish to take part, they can stop taking part in the research without giving any reason or explanation. We will also destroy any data we have collected from your child so far and it will not be used in the research.

What will happen if my child does take part?

If you and your child give permission to take part, we would ask that you are involved in the study for approximately 4 weeks. Although this may seem like quite a lot of work, the time involved each day during the study may typically be quite small, approximately **20 minutes**. You and your child will not need to take part in the study at weekends and all appointments times will be at a time that is convenient for you and your child. All appointments will either be at your home or at your child's school. These meetings should last no longer than an hour.

First, we will arrange a convenient time to meet with you and your child to explain the study in detail. We will then ask you and your child to complete a form to indicate that you are willing to participate in the study. During this session we will ask your child to complete a brief assessment of memory and some other brief measures. This appointment will take about 1 hour in total at your home or at your child's school. If we find that your child does not have difficulties in remembering to do things in the future, then we will not continue with the study. If this happens, then we will let you know about other research studies that we are running in case these are also of interest to you.

If we find that your child does have difficulties in remembering to do some things, then we will arrange to meet with you and your child again, within two weeks, to complete further pen and paper assessments of general thinking, memory, and attention abilities, and some questionnaires. This will take approximately 1 hour.

We will then ask your child to remember to send a text message to us, at three set times per working day. This will not take place during school time, and the times that they have to send text messages will be set at a time that suits you and your child. We will also ask your child to set three goals each day, of things that they would like to remember to do. This could be anything, such as remembering to feed a pet, for example. However, these goals would be things that you would know if they have achieved or not. We will then ask both you and your child to rate how successful they have been in remembering their goals. If you are happy, we will call each day to collect the goal ratings, and to help set new goals for the following day if that would be helpful. Please note that if your child is doing well at these tasks after twelve working days then they will not need to take part in the study any further and they will be withdrawn from the study.

After either six or twelve working days (depending on how your child has done so far), we will give your child some training about things they can do to help them to remember to do things. After this, we will send reminder “STOP” text messages on some days. This is to remind them to use the strategy we will have taught them during the training session, to prompt them to send the text messages at set times, and to review their own goals. This will happen for twelve working days in total. After six working days (half-way through the study), we will repeat the training with them, to remind them what the “STOP” texts mean.

At the end of the study, we will ask you and your child what you thought of the training and text messages. All research costs will be reimbursed to you in full, such as any travel costs or phone credit.

Are there any risks to my child if they take part?

The study involves completing paper and pencil assessments, and two training sessions to teach them a way of remembering to do things. We are also asking you and your child to commit to the study for approximately 4 weeks in total. All text times will be set by you and your child, at a time that is convenient.

At the start of the study, we shall ask your child to complete some tests that will assess memory and other thinking skills. These tests are designed especially for children and adolescents, and are quite commonly used without causing any upset. However, testing will be stopped immediately if your child becomes tired or stressed in any way. To minimise the risk of becoming tired, the assessments can be conducted over a couple of shorter sessions, if this is preferred, and regular breaks for a rest will be included. In the unlikely event that your child becomes stressed or upset in any way, the assessments will be stopped immediately and reasons for their distress will be explored.

What are the potential benefits?

By participating in this study, you will be contributing to research investigating memory difficulties in children. You will also be helping us to work out how good our memory training programme is for children and adolescents. As a small token of our appreciation for taking part, your child will be given an age-appropriate trinket at the end of the study (such as stickers, pens, or a keyring).

Will my child’s information be kept confidential?

All information will be made anonymous, and confidentiality and security of all data will be maintained at all times. This means we will not write your name or your child’s name or address on any questionnaires or score sheets. Written data will be kept in a secure location (a locked filing cabinet at the University of Bristol). No identifying information (including names) will accompany the data; instead, a number will be used to identify each young person to protect their anonymity.

When the study is finished all information collected from questionnaires and other study measures will be stored in a locked drawer, at the University of Exeter, for a minimum of 5 years and up to a maximum of 10 years. It will then be destroyed. If you agree to have your contact details added on to the Volunteer Register, we will contact you before 5 years elapses to ask if you wish to remain on the Register. We would also like to let your child’s GP know that s/he is taking part in the research. This is in case you would like to discuss the study with their GP. However, no results will be shared with their GP without your permission. The only time we would disclose any of the information that you or your child has

given us, would be if criminal or other potentially harmful behaviour was made known. We would, however, aim to discuss this with you first.

What will happen to the results of the study?

The results will be submitted to peer-reviewed journals and presented at conferences and meetings. Yours and your child's names will not be included on any research outputs, and all data will be presented anonymously.

If you would like to know how your child performed on their measures of general thinking, memory, and attention abilities, then we can give you a brief report summarising this. This report will be written under the supervision of Dr Anna Adlam (Clinical Psychologist), and you can give a copy of the report to your child's school, GP, or other health professionals working with your child. We can also give you an overall summary of the study findings for your information.

Who is organising the research?

The University of Exeter is running and funding the study. Please note that the researchers are not being paid to conduct this research.

Who has reviewed the study?

In order to ensure that it is safe and appropriate for those taking part, all research is reviewed by a research panel. This study has been reviewed and approved by the University of Exeter Ethics Committee.

Are there more research studies my child could engage in?

The Centre for Clinical Neuropsychology (CCNR) is currently building a research participant register so that people who are interested can be contacted directly about new research studies. If you and your child would like to take part in further studies of this kind then we can indeed add you to the register. Your contact details would be stored, in addition to your child's name, date of birth, and sex, on a secure volunteer panel, which is managed by Dr. Anna Adlam. This information will be maintained in accordance with the Data Protection Act (1998) and will not be shared with anyone outside of the University of Exeter. You will only be sent details of studies that have received full ethical approval from the University of Exeter's Research Committee. The panel will be reviewed every 5 years to offer you the chance to opt out, should you wish to. To join the volunteer register, please contact the research team via ccnr@exeter.ac.uk and indicate 'Volunteer Panel' in the subject heading.

What if there is a problem?

If you have any questions or experience any difficulties then please contact a member of the research team. If you would like to make a complaint, please contact Dr Anna Adlam (contact details are below).

What to do if you would like to take part?

Enclosed is a consent form to share your contact details with the research team. This is for you to complete if you would like to take part in the study. You need to fill in the form, initial all the boxes, sign and send it back to us using the Freepost envelope provided or give it to you to the teacher who alerted you about our study. We will then telephone you to arrange the first meeting. We can only contact you if you return the 'consent to share your contact details' form to us.

Further information and contact details

For further information about the project please contact Mr Steven Mahan (sm519@exeter.ac.uk) or Dr Anna Adlam (A.R.Adlam@exeter.ac.uk) at the University of Exeter, Centre for Clinical Neuropsychology Research (CCNR), School Of Psychology, College of Life and Environment Sciences, Exeter, EX4 4QG. Telephone: **01392 722209** (office telephone). We will be happy to answer any questions that you might have.

Thank you for reading this information sheet

PARTICIPANT INFORMATION SHEET (10-15 years)

Prospective Memory in Children and Adolescents

Researchers: Mr Steven Mahan and Dr Anna Adlam

We would like to invite you to take part in our research study. The research would involve you being taught a way of trying to help you with remembering to do things, receiving and sending some text messages, and setting some goals, which you will try to do each day. The research will not take part during your school time.

Before you decide to take part, we would like to tell you why the research is being done and what we will ask you to do. Please read the information carefully or ask someone to read it to you so you can decide if you want to take part or not. You do not have to decide straight away if you would like to take part in this research. You can talk about it with your family and friends or doctor if you want to. Feel free to ask us if there is anything that you do not understand.



What is this study about?

‘Prospective Memory’ is when someone has to remember to pass on a message to a friend, or remember to post a card for a friend’s birthday, for example. It is simply when we remember to do something at a later time. We are looking at a way of trying to help children and adolescents who struggle with how they plan, organise, and remember to do things at a later time. We are looking at whether sending people text messages that read “STOP” (which reminds them to Stop, Think, Organise, and Plan) can help them to remember to carry out something they had planned to do.

Why do you want me to take part?

We would like teenagers between 10 and 18 years old to take part, who have difficulties with remembering to do things at a later time. We will check if you struggle with remembering to do things in the future (by completing a couple of pen and paper tests, which are a bit like a quiz) before asking you to take part in the whole study.

Do I have to take part?

No, it is entirely up to you and your parent(s)/guardian(s) if you wish to take part or not. You and your parent(s)/guardian(s) will be asked to sign a form to say that you are happy to take part. However, you can still change your mind and stop taking part in the study at any time, without telling us why if you don’t want to.



What will happen if I do take part?

If you would like to take part, we would ask that you are involved in the study for around 4 weeks. Although this may seem like quite a lot of work, you would probably only be doing things for the research for about **20 minutes each day**. You will not need to take part in the study at weekends.

First, we will arrange a good time to meet with you and your parent(s)/guardian(s) to explain the study. During this session, we will ask you to complete a couple of tests to see how your memory is and some other brief measures. Some are a bit like doing a quiz, and some are like doing a puzzle. Your parents can be there for this if you would like them to. If we find that you do not have difficulties in remembering to do things in the future, then we will not ask you to do anything else for this study.

If we find that you do have some memory difficulties, then we will meet with you again to complete a few more pen and paper tasks, which look at your ‘thinking skills’, such as your



memory and attention, and some questionnaires (again, these are like doing a quiz or a puzzle).

We will then ask you to remember to send a text message to us, at three set times each day (but not at weekends). This will not take place during school time, and the times that you have to send text messages will be set at a time that suits you. We will also ask you to set three goals each day, of things that you would like to remember to do. This could be anything, such as remembering to feed a pet, for example. However, these goals would be things that your parents would know if you have done or not. We will then ask you and your parents to rate how much of your goal you have remembered to do. If you are doing well on these tasks after twelve days, you will not need to help us with the study any further and we will withdraw you from the study.

After either six or twelve days (depending on how you have done so far), we will give you some training about things you can do to help you to remember to do things. After this, we will send reminder “STOP” text messages on some days. These “STOP” texts are to remind you to send the text messages at set times, and to think about how you’re doing on your goals. This will happen for twelve days all together. Half-way through the study, we will repeat the training with you to remind you what the “STOP” texts mean.

What is good about the study?

By helping us with this study, you are helping us to learn more about what might help children and adolescents with memory difficulties. To say thank you for taking part, at the end of the study we will give you a small gift, such as stickers, pens, or a keyring, for example.

What is not so good, about the study?

In this study we will ask you to do some paper and pencil tasks, and two training sessions to teach you a way of remembering to do things. One of the not so good things about taking part is that you might feel a bit tired when doing some of these tasks. To help you feel less tired, we will have plenty of breaks for a rest. If you feel upset or stressed when doing these tasks, we can stop and we will ask you if you want to talk about it. We can either carry on after a break, or we can stop completely. It will be up to you.

Who will know what I have said?

Only the researchers will know how you have done on the tasks and they will not be allowed to tell anyone else how you did without your parent(s)/guardian(s) permission. The answers that you give will be kept safely locked away in a filing cabinet at the University. Your name will not be written on any of your answer sheets. If your parent(s)/guardian(s) want us to, then we might tell your doctor that you have taken part in the study. If you tell us something that worries us, then we might have to share it with someone else. We will let you know if we plan to do this.

The study findings might appear in magazines for medical doctors and scientists to read. Your name will not be included. If you and your parent(s)/guardian(s) want, then we will write you a letter to tell you how you did on the tasks.

What happens at the end of the study?

When the study is finished, the research team will write about the results in research magazines, and will present the results at research meetings. Nothing that we write or talk about will have your name in it. At the end of the research, we can also send you a short letter to tell you what we found overall.

Is the research safe and who has checked it?

This research has been looked at by a separate group of people called a Research Ethics Committee. The group of people have decided that it is safe for you to take part in.

What do I do if I want to take part?

Your parent(s)/guardian(s) have also received information about this study. If you would like to take part, let me know. If they are also happy for you to take part, let them know and, if they are also happy for you to take part, they will contact us for you.

Thank you for reading this information sheet!



PARTICIPANT INFORMATION SHEET (16-18 years)

Prospective Memory in Children and Adolescents

Researchers: Mr Steven Mahan and Dr Anna Adlam

We would like to invite you to take part in a research study, which is looking at a way of helping young people who find it hard to remember to do some things. The research would involve you being taught a way of trying to help you with remembering to do things, receiving and sending some text messages, and setting some daily goals, which you will try and achieve. The research will not interfere with (or take part during) your education or work time.

Before you decide to take part, it is important for you to understand why the research is being done and what you would have to do if you took part. Please take time to read the following information carefully and discuss it with your friends, family, or GP if you wish. Please do not hesitate to contact us if there is anything that is not clear or if you would like more information (contact details can be found at the bottom of this sheet). You do not have to decide straight away if you would like to take part in this research. Thank you for reading this.

What is this study about?

‘Prospective Memory’ is when someone has to remember to pass on a message to a friend, or remember to post a card for a friend’s birthday, for example. It is simply when we remember to do something at a later time. Lots of people say they find it hard to remember to do things at a later time, but some people struggle with this quite a bit.

We are looking at a way of trying to help children and adolescents who struggle with how they plan, organise, and remember to do things at a later time. We are looking at whether sending people text messages that read “STOP” (which reminds them to Stop, Think, Organise, and Plan) can help them to remember to carry out something they had planned to do.

Why do you want me to take part?

We would like around 10 teenagers between the ages of 10 and 18 years to take part, who have trouble with remembering to do things in the future. If you would like to take part, we will check if you struggle with remembering to do things in the future (by doing a brief screening assessment) before asking you to take part in the whole study.

Do I have to take part?

No, it is entirely up to you if you wish to take part or not. If you do not want to take part we will respect your decision. If you do want to take part, we will ask you to first sign a consent form before you begin the study, to show that you have given your permission to be in the study. We will give you a copy of the forms and this information sheet to keep. If at any time you decide that you no longer want to take part, you can stop taking part in the research without giving any reason or explanation. We will also destroy any data we have collected from you so far and it will not be used in the research.

What will happen if I do take part?

If you give your permission to take part, we would ask that you are involved in the study for around 4 weeks. Although this may seem like quite a lot of work, the time involved each day during the study would be quite small, roughly around **20 minutes**. You will not need to take part in the study at weekends and all appointments times will be at a time that suits you. All appointments will either be at your home or at your school. These meetings should last no longer than an hour.

First, we will arrange a time that suits you to meet with you to explain the study in detail. We will then ask you to complete a form to show that you are willing to be in the study. During this session we will ask you to complete a brief assessment of memory and some other brief measures. This appointment will take about 1 hour in total at your home or at your school. Your parents can be there for this if you would like them to. If we find that you do not have memory difficulties, then we will not continue with the study. If this happens, then we will let you know about other research studies that we are running in case these are also of interest to you.

If we find that you do have some memory difficulties, then we will arrange to meet with you again, within two weeks, to complete further pen and paper assessments of your ‘thinking skills’, such as your memory and attention, and some questionnaires. This will take approximately 1 hour.

Trainee Number: 12/01017

We will then ask you to remember to send a text message to us, at three set times per working day. This will not take place during school or work time, and the times that you have to send text messages will be set at a time that suits you. We will also ask you to set three goals each day, of things that you would like to remember to do. This could be anything, such as remembering to feed a pet, for example. However, these goals would be things that your parent(s)/guardian(s) would know if you have achieved or not. We will then ask you and your parent(s)/guardian(s) to rate how successful you have been in remembering your goals. If you are happy, we will call each day to collect the goal ratings, and to help set new goals for the following day if that would be helpful. Please note that if you are doing well at these tasks after twelve working days then you will not need to take part in the study any further and you will be withdrawn from the study.

After either six or twelve working days (depending on how you have done so far), we will give you some training about things you can do to help you to remember to do things. After this, we will send reminder "STOP" text messages on some days. This is to remind you to use the strategy we will have taught you during the training session, to remind you to send the text messages at set times, and to review your own goals. This will happen for twelve working days in total. After six working days (half-way through the study), we will repeat the training with you to remind you what the "STOP" texts mean.

At the end of the study, we will ask you what you thought of the training and text messages. We will cover all research costs for you (such as phone credit). You will not have to pay for anything.

Are there any risks to me if I take part?

The study involves completing paper and pencil assessments, and two training sessions to teach you a way of remembering to do things. We are also asking you to take part in the study for around 4 weeks in total. You will be able to set the texts times at a time that suits you.

At the start of the study, we shall ask you to complete some tests that will assess memory and other thinking skills. These tests are designed especially for children and adolescents, and these tests do not normally upset people. However, we will stop the testing straight away if you become tired or stressed in any way. These tests can be carried out over a couple of shorter sessions, if this is preferred, and regular breaks for a rest will be included. If you do become upset in any way, we can stop straight away and we will try and find out why you became upset.

What are the potential benefits?

By taking part in this study, you will be helping with research that looks at memory in children and adolescents. You will also be helping us to work out how good our memory training programme is for children and adolescents. As a small token of our thanks, we will give you a trinket of your choice for taking part (such as pens or a key ring, for example).

Who will know what I have said?

All information will be made anonymous, and confidentiality and security of all data will be maintained at all times. This means we will not write your name or address on any questionnaires or score sheets. Written data will be kept in a secure location (a locked filing cabinet at the University of Exeter). No identifying information (including names) will accompany the data; instead, a number will be used to identify each young person to protect their anonymity.

When the study is finished all information collected from questionnaires and other study measures will be stored in a locked drawer, at the University of Exeter, for a minimum of 5 years and up to a maximum of 10 years. It will then be destroyed. If you agree to have your contact details added on to the Volunteer Register, we will contact you before 5 years elapses to ask if you wish to remain on the Register. We would also like to let your GP know that you are taking part in the research. This is in case you would like to discuss the study with them. However, no results will be shared with your GP without your permission. The only time we would disclose any of the information that you have given us, would be if we were worried about your (or others') safety. We would, however, aim to discuss this with you first.

What will happen once I have taken part in the study?

The results will be submitted to peer-reviewed journals and presented at conferences and meetings, but this will be done anonymously; no one will know it was your results.

If you would like to know how you did on the standardised measures of 'thinking skills' then we can give you a brief report summarising this. This report will be written under the supervision of Dr Anna Adlam

Trainee Number: 12/01017

(Clinical Psychologist), and you can give a copy of the report to your school or work, GP. We can also give you an overall summary of the study findings for your information.

Who is organising the research?

The University of Exeter is running and funding the study. Please note that the researchers are not being paid to conduct this research.

Who has reviewed the study?

In order to ensure that it is safe and appropriate for those taking part, all research is reviewed by a research panel. This study has been reviewed and approved by the University of Exeter Ethics Committee.

Are there more research studies that I could take part in?

The Centre for Clinical Neuropsychology (CCNR) is currently building a research participant register so that people who are interested can be contacted directly about new research studies. If you would like to take part in further studies of this kind then we can add you to the register. Your contact details would be stored, along with your name, date of birth, and sex on a secure volunteer panel, which is managed by Dr. Anna Adlam. This information will be maintained in accordance with the Data Protection Act (1998) and will not be shared with anyone outside of the University of Exeter. You will only be sent details of studies that have received full ethical approval from the University of Exeter's Research Committee. The panel will be reviewed every 5 years to offer you the chance to opt out, should you wish to. To join the volunteer register, please contact the research team via ccnr@exeter.ac.uk and indicate 'Volunteer Panel' in the subject heading.

What if there is a problem?

If you have any questions or experience any difficulties then please contact a member of the research team. If you would like to make a complaint, please contact Dr Anna Adlam (contact details are below).

What to do if you would like to take part?

Enclosed is a consent form to share contact details for you to complete if you would like to take part in the study. You need to fill in the form, initial all the boxes, sign and send it back to us using the Freepost envelope provided or give it to the teacher who told you about our study. We will then telephone you to arrange the first meeting. We can only contact you if you return the 'consent to share your contact details' form to us.

Further information and contact details

For further information about the project please contact Mr Steven Mahan (sm519@exeter.ac.uk) or Dr Anna Adlam (A.R.Adlam@exeter.ac.uk) at the University of Exeter, Centre for Clinical Neuropsychology Research (CCNR), School Of Psychology, College of Life and Environment Sciences, Exeter, EX4 4QG. Telephone: **01392 722209** (office telephone). We will be happy to answer any questions that you might have.

Thank you for reading this information sheet

I. GMT Presentation and Handout



Remembering
Goals Training

Adapted by C. Steiner, D.A. & S. Adams (2012)
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1

This slide features a blue background with a white box containing the title 'Remembering Goals Training'. To the left is a mobile phone icon, and to the right is a yellow smiley face character holding a pencil and writing on a notepad. At the bottom, there is a small copyright notice and the number '1' in a blue box.

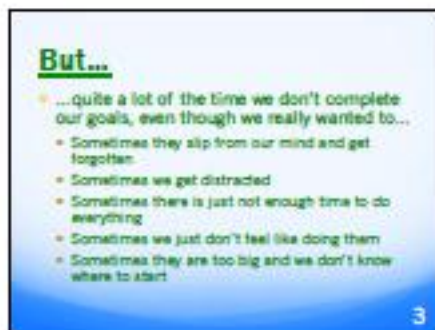


Remembering things

- Goals or intentions are things that we plan to do (like meet a friend or go to a party)
- Our memory for these things that we plan to do in the future is called 'Prospective Memory'

2

This slide has a blue background. The title 'Remembering things' is underlined in green. Below it are two bullet points. The second bullet point includes the term 'Prospective Memory' in quotes and underlined. A small image of a yellow notepad is shown below the text. The number '2' is in a blue box at the bottom right.



But...

- ...quite a lot of the time we don't complete our goals, even though we really wanted to...
 - Sometimes they slip from our mind and get forgotten
 - Sometimes we get distracted
 - Sometimes there is just not enough time to do everything
 - Sometimes we just don't feel like doing them
 - Sometimes they are too big and we don't know where to start

3

This slide has a blue background. The title 'But...' is underlined in green. It contains a main bullet point followed by a sub-list of five reasons why goals are not completed. The number '3' is in a blue box at the bottom right.



For example

- Sometimes we might forget to take our dog for a walk even though we meant to

"Ooops!"

Can you think of a time when something like this happened to you?

4

This slide has a blue background. The title 'For example' is underlined in green. It features a single bullet point about forgetting to walk a dog. Below the text is a cartoon character with a red shirt and a speech bubble saying 'Ooops!'. A question is asked at the bottom. The number '4' is in a blue box at the bottom right.




Memory Mistakes

- We have to remember **WHAT** we want to do and **WHEN** we want to do it
- This isn't easy and we all make mistakes
- But sometimes it can happen more after brain injury or from things like epilepsy
- Often these mistakes occur
- Not because you can't do it
- But because your mind was not focusing on what you were doing at the time

5

This slide has a blue background. The title 'Memory Mistakes' is underlined in green. It contains a list of six points explaining memory mistakes. The number '5' is in a blue box at the bottom right.



Automatic Pilot

- Not paying attention to things all the time is called **AUTOMATIC PILOT**, like a robot doing things without needing to think about them
- Sometimes it can be helpful
- Because many tasks are routine (like brushing your teeth) and the automatic pilot can take care of these for us so we can think about other things

6

This slide has a blue background. The title 'Automatic Pilot' is underlined in green. It contains a list of three points. The second point includes the term 'AUTOMATIC PILOT' in all caps. A cartoon robot character is shown on the right side. The number '6' is in a blue box at the bottom right.

Automatic Pilot - Problems

- But it can be unhelpful because it can make us forget to do things and slip up.



Examples of this kind of 'slip' are:

- Walking to your old classroom instead of your new one at the start of a new school term
- Helping to clear the table after dinner and putting the butter in the dishwasher and dirty plates in the fridge
- Going into a room and forgetting what you went there for
- Having to read something again because you weren't paying attention
- Daydreaming instead of listening to something



The Automatic Pilot

- Can you think of a time in the last week or month when things have gone wrong because your mind wasn't really on what you were doing?

8

Stopping the Automatic Pilot

- It is hard to stop the automatic pilot
- It can cause serious problems (like making us late or not doing the thing that we meant to)

• But...


- A good way to stop ourselves from being out autopilot is to get into the habit of checking whether we are doing the right thing we need to be...

- **We can do this by telling ourselves to "STOP!" and think!**


9

The Mental Whiteboard

- When we are doing something we have an instruction for that task in our head
- You can imagine it gets wiped clean like a whiteboard at school
- So our short term memory is like a whiteboard
- If we get distracted by something, the instruction get wiped off the whiteboard before we get a chance to do it



Alice and Adam



Alice and Adam were friends. They were sitting together on the bus to school one morning.


Adam's Mum had asked him to post an important letter for her when he got off the bus, because there was a post box just outside of the school gates.

Adam had written on his mental whiteboard "post letter".

Alice and Adam were talking about the weekend. Alice told Adam about a surprise present her parents had bought her (a brand new Xbox Game that had already sold out in the shops).


11

Alice and Adam



Adam's instructions to post the letter were wiped off the whiteboard to make room for Alice's news.

Because he was thinking about when he could go round and play the game, Adam forgot to post the letter when he got to school. He only remembered when he was sitting on the bus to go home.



If Adam had checked his mental whiteboard, he would have been much more likely to post the letter.

12

Checking the Mental Whiteboard

- We can stop things from getting wiped from our mental whiteboard and we can stop ourselves going on autopilot by:
 - **Telling ourselves to "STOP" and think!**
- Try and get into the habit of stopping the automatic pilot and checking whether it is the right thing to be doing...
- To begin with it takes effort
- But using the "STOP" idea to check what should be on the whiteboard to help

13

The Mental Whiteboard

- Can you think of a time in the last week or month when something slipped off your mental whiteboard, but you remembered it later?
- For example:
 - Forgetting to take something to school
 - Forgetting to pass on a message
 - Forgetting to do homework



Summary

- Our short term memory is like a mental whiteboard - it doesn't have much space and can easily get wiped clean by distraction
- We often forget to do things we needed to do
- We can use the word "STOP" to interrupt our automatic pilot
- We can also use the "STOP" moment as a reminder to check what should be on our mental whiteboard
- This can help us to remember what we need to be doing instead of other people reminding us

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Exercise 1.

Practice putting something on your mental whiteboard

- Please try and remember to say "Pink Elephant" in 10 minutes time
- Imagine writing this onto your mental whiteboard
- Use an image - the odder the better - to help you remember (such as a clock made with elephant shaped hands pointing to the time you need to say "Pink Elephant")

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Exercise 2.

Practice putting something on your mental whiteboard

- Multiple tasks - try to do 3 things in 2 minutes
- Multiple tasks - try to do 3 things in 2 minutes with "STOP" breaks



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Strategy to try at home



18

"STOP!" Text Messages

- During the next couple of weeks you will receive some texts that say "STOP!" at random times
- These won't be sent at weekends
- This is a strategy that can help you to remind yourself rather than other people telling you



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"STOP!" Text Messages

- When you get a text message saying "STOP!" you should stop what you are doing, if it is safe to do so, and think about the things you have to do that day
- This will include sending a text to me but also anything else you need to remember to do, like the daily goals we've been setting together



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"STOP!" Text Messages

- When you get a text message, ask yourself to:
Stop **S...**
Think **T...**
Organise **O...**
Plan **P...**
- You can also ask yourself these types of questions:
 - What have I got to do and when?
 - Do I need to be concentrating?
 - Do I need to do anything differently now?
 - Is it OK to just carry on with what I'm doing?
 - What is it I'm supposed to be doing now?



21

When I get a text message saying "STOP!", I should stop what I am doing, if it is safe to do so, and think about the texts to Steve and my other goals.



22

What do I have to do?

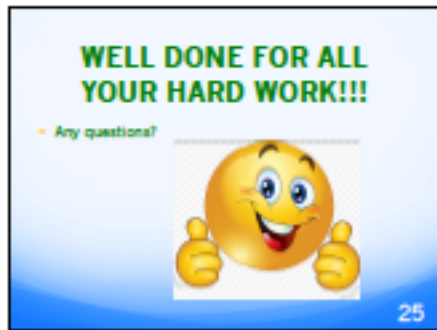
23

Don't forget to...

STOP
THINK
ORGANISE
PLAN



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Remembering Goals Training Participant Handout



- Goals or intentions are things that we plan to do (like meet a friend or go to a party)
- Our memory for these things that we plan to do in the future is called **'Prospective Memory'**

BUT

- ...quite a lot of the time we don't complete our goals, even though we really wanted to...
 - Sometimes they slip from our mind and get forgotten
 - Sometimes we get distracted
 - Sometimes there is just not enough time to do everything
 - Sometimes we just don't feel like doing them
 - Sometimes they are too big and we don't know where to start
- Sometimes we might forget to take our dog for a walk even though we meant to
- Can you think of a time when something like this happened to you?

MEMORY MISTAKES

- We have to remember **WHAT** we want to do and **WHEN** we want to do it
- This isn't easy and we all make mistakes
- But sometimes it can happen more after brain injury or from things like epilepsy
- Often these mistakes occur
- Not because you can't do it
- But because your mind was not focusing on what you were doing at the time

AUTOMATIC PILOT

- Not paying attention to things at the time is called AUTOMATIC PILOT, like a robot doing things without needing to think about them.
- Sometimes it can be helpful because many tasks are routine (like brushing your teeth) and the automatic pilot can take care of these for us so we can think about other things



AUTOMATIC PILOT PROBLEMS

- But it can be unhelpful because it can make us forget to do things and slip up.
- Examples of this kind of 'slip' are:
- Walking to your old classroom instead of your new one at the start of a new school term
- Helping to clear the table after dinner and putting the butter in the dishwasher and dirty plate in the fridge
- Going into a room and forgetting what you went there for
- Having to read something again because you weren't paying attention
- Day dreaming instead of listening to something
- Can you think of a time in the last week or month when things have gone wrong because your mind wasn't really on what you were doing?

STOPPING THE AUTOMATIC PILOT

- It is hard to stop the automatic pilot
- It can cause serious problems (like making us late or not doing the thing that we meant to)
- But...
- A good way to stop ourselves from being out autopilot is to get into the habit of checking whether we are doing the right thing we need to be...
- **We can do this by telling ourselves to "STOP!" and think!**



THE MENTAL WHITEBOARD

- When we are doing something we have an instruction for that task in our head
- You can imagine it gets wiped clean like a whiteboard at school
- So our short term memory is like a whiteboard
- If we get distracted by something, the instruction get wiped off the whiteboard before we get a chance to do it



Story: Alice and Adam

Alice and Adam were friends. They were sitting together on the bus to school one morning.

Adam's Mum had asked him to post an important letter for her when he got off the bus, because there was a post box just outside of the school gates.

Adam had written on his mental whiteboard "post letter".

Alice and Adam were talking about the weekend. Alice told Adam about a surprise present her parents had bought her (a brand new Xbox Game that had already sold out in the shops).

Adam's instructions to post the letter were wiped off the whiteboard to make room for Alice's news.

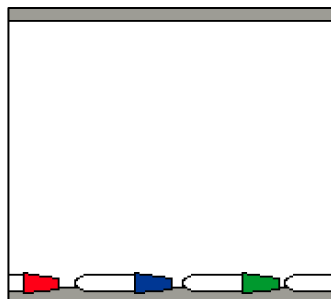
Because he was thinking about when he could go round and play the game, Adam forgot to post the letter when he got to school. He only remembered when he was sitting on the bus to go home.

If Adam had checked his mental whiteboard, he would have been much more likely to post the letter.



CHECKING THE MENTAL WHITEBOARD

- We can stop things from getting wiped from our mental whiteboard and we can stop ourselves going on autopilot by:
- **Telling ourselves to "STOP!" and think!**
- Try and get into the habit of stopping the automatic pilot and checking whether it is the right thing to be doing...
- To begin with it takes effort
- But using the "STOP!" idea to check what should be on the whiteboard to help
- Can you think of a time in the last week or month when something slipped off your mental whiteboard, but you remembered it later?
- For example:
 - Forgetting to take something to school
 - Forgetting to pass on a message
 - Forgetting to do homework



SUMMARY

- Our short term memory is like a mental whiteboard. It doesn't have much space and can easily get wiped clean by distraction.
- We often forget to do things we needed to do.
- We can use the word **"STOP!"** to interrupt our automatic pilot.
- We can also use the **"STOP!"** moment as a reminder to check what should be on our mental whiteboard
- This can help us to remember what we need to be doing instead of other people reminding us.

'STOP' TEXT MESSAGES

- During the next couple of weeks you will receive some texts that say "STOP!" at random times
- These won't be sent at weekends
- This is a strategy that can help you to remind yourself rather than other people telling you
- When you get a text message saying **"STOP!"** you should stop what you are doing, **if it is safe to do so**, and think about the things you have to do that day.
- This will include sending a text to me but also anything else you need to remember to do, like the daily goals we've been setting together.

- When you get a text message, ask yourself to:

- **Stop** **S....**
- **Think** **T...**
- **Organise** **O...**
- **Plan** **P...**



- You can also ask yourself these types of questions:
 - What have I got to do and when?
 - Do I need to be concentrating?
 - Do I need to do anything differently now?
 - Is it OK to just carry on with what I'm doing?
 - What is it I'm supposed to be doing now?



Remembering Goals Training

Participant Quiz

1. What does 'STOP' stand for?

S.....

T.....

O.....

P.....



2. What are you going to do when you get a text message reading 'STOP'?

3. What kind of questions could you ask yourself when you receive a 'STOP' text message?

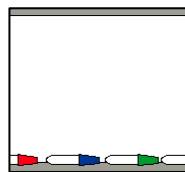


4. Slips....can you think of a time when you made a memory mistake because you were not concentrating?

5. How might stopping and thinking about things help you?

6. Can things fall off of your mental whiteboard if you don't check them?

Yes or No



7. What are the main things that you will remember from today?



WELL DONE FOR ALL YOUR HARD WORK!!!

J. Summary of Qualitative Feedback

Participant	“What did you like about the intervention?”	“Would you change anything about the intervention?”	“Would anything have helped you to remember more?”
One	“It helped me to remember my goals”	“Sometimes sending texts was boring. Maybe just doing goals would be better”	“Having “STOP” texts closer to when I had to send a text”
Two	“It’s easy to continue on my own with it”	“Having more “STOP” texts, not just six”	“Just getting more frequent “STOP” texts throughout the day”
Three	Participant disengaged before providing feedback		
Four	“It was good because I always have my phone on me”	“Nothing”	“I can’t think of anything”
Five	“I thought the training was fun and easy to do. It was helpful to have the training twice”	“I wish I had more “STOP” texts closer to when I had to text”	“I needed “STOP” texts nearer the time I had to text you. I kept forgetting and being late”
Six	“It really helped me to stop and think about what I was doing”	“I don’t think so. I enjoyed it”	“Maybe some “STOP” texts at the time I had to text you, like an alarm”
Seven	“When I got the “STOP” texts, I found myself trying hard to remember things”	“Nothing”	“No – I think I remembered lots anyway”
Eight	“I was worried the training would be really hard, but it was quite simple”	“Sometimes I wish the “STOP” text had been closer to when I needed to send the texts”	“Just to have more “STOP” texts”

K. Subjective Experiences of Intervention

Question	Participant Number and Rating:							
	(0 = Not at all; 10 = Very/A lot)							
	1	2	3	4	5	6	7	8
Routine:								
How easy was it to remember to send text messages as part of your daily routine?	3	4	-	8	4	10	3	10
How easy was it to remember to do your goals as part of your daily routine?	6	5	-	6	7	0	3	10
Taking time to think:								
How adequately did you take time out from what you were doing to think about the text message task during the day?	4	6	-	10	5	5	5	10
How adequately did you take time out from what you were doing to think about doing your goals during the day?	6	5	-	4	7	7	5	10
Autopilot:								
How much do you think you were on autopilot during the study?	7	6	-	5	5	8	9	1
Achievement:								
How much of what you intended to achieve did you achieve during the study?	6	7	-	7	8	9	2	9
Intentions:								
How much did the training help you to carry out your goals and other intentions?	9	9	-	9	9	10	7	9
Effort:								
How hard did you try to remember to send text messages?	5	6	-	9	6	10	7	10
How hard did you try to remember to do your goals?	8	8	-	8	9	6	7	10
Motivation:								
How motivated were you to send text messages?	5	6	-	10	6	10	6	10
How motivated were you to do your goals?	8	5	-	6	8	10	7	10
Importance:								
How important was it to you to remember to send the text messages?	6	5	-	9	6	10	6	10
How important was it to you to remember to do your goals?	10	6	-	6	10	10	6	10
Difference:								
How much difference did the "STOP" strategy make to you?	8	9	-	8	9	10	8	8

L. Dissemination Statement

The results of this study will be disseminated to interested parties through feedback, journal publication and presentation.

Dissemination to participants and NHS services

As stated on the participant information sheet participants will be informed of the results of the study. Participants will be provided with details of who to contact, should they require further information. The NHS research ethics committee at Exeter and RD&E Research and Development team will be sent a summary of the findings of the study and will be informed that the study is now complete.

Journal Publication

It is expected that the study and systematic review will be submitted for publication with the Journal of International Neuropsychological Society.

Presentation

On 8th June 2015, my research findings will be presented to an academic audience, for peer review, as part of the Doctorate in Clinical Psychology at the University of Exeter.