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A Positive Behavioural Intervention on Prospective Memory of Children with Autism

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ABSTRACT

Prospective memory is remembering to carry out a behaviour on a particular occasion or at a specific point in time in the future. This form of memory is particularly critical for the daily functioning of children with Autism Spectrum Disorder and their functional independence from their caregivers. My first aim was to assess the prospective memory abilities of each child when completing virtual week. My second aim was to investigate if reinforcing the prospective remembering of children with Autism Spectrum Disorder increased the probability of those behaviours occurring again. Four children with a diagnosis of ASD participated in a computerised board game called 'Virtual Week'. Using a single-subject design, baseline, positive reinforcement, and maintenance or prompt phases were implemented for each child. For every correct prospective memory response in the positive reinforcement phase they received positive reinforcement. Positive reinforcement increased the accuracy of prospective memory responses for all participants. Data for all participants showed a decrease in missed responses and an increase in correct responses to the Prospective Memory tasks. These effects were maintained after reinforcement was discontinued for three out of four children. This is the first study of which I was aware to use a positive behavioural intervention to improve the prospective memory behaviours of children with ASD. Reinforcing prospective remembering in real-life situations using say-do correspondence training could extend research in this area.

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Ethical Considerations

The Research Committee of the Psychology Department of the University of Waikato granted formal approval for this research. Consent to work with children was given by the children's parents.

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Autism spectrum disorders are complex developmental disorders that may cause issues with thinking, feeling, language, and the ability to relate to others. The American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013) now defines autism Spectrum Disorder (ASD) as a single disorder. This includes Autism, Asperger's Syndrome, Childhood Disintegrative Disorder and Pervasive developmental disorder not otherwise specified (American Psychiatric Association, 2013). There are a number of characteristics that may be present in an individual with a diagnosis of ASD such as impairments in reciprocal interactions, impairments in verbal and non-verbal communication skills and stereotypical behaviours (American Psychiatric Association, 2013). Furthermore, evidence suggests that those with ASD also have deficits in executive functioning (Corbett, Constantine, Hendren, Rock, & Ozonoff, 2009; Mackinlay, Kliegel, & Mantayla, 2009; Mahy & Moses, 2011; Yi et al., 2014). Executive functioning refers to the neuropsychological processes of response inhibition, working memory, cognitive flexibility, planning, and fluency (Corbett, 2009). Deficits in executive control are one of the key cognitive characteristics in individuals with ASD. Thus due to lower levels of executive functioning, it is expected that children with ASD will have deficits in different forms of memory such as retrospective memory and prospective memory.

Prospective memory is remembering to carry out a behaviour on a particular occasion or at a specific point in time in the future. It is an important part of daily cognition and it represents a crucial element in planning and controlling everyday activities (Brandimonte, Einstein, & McDaniel, 1996). This form of memory is particularly critical for the daily functioning of children, as they grow older and more independent from their caregivers. In order for children

to become independent they must develop the ability to carry out planned future intentions, in particular, when these behavioural intentions are being carried out in the presence of other ongoing activities that occur in daily life. When children reach school age it is expected that they are able to carry out some of their own intentions and future tasks that are expected of them by others. For example, children are often expected to remember to bring their homework book in on its due date or to buy a present for their friend for their birthday party.

Brandimonte (1991) identified a number of behavioural characteristics of prospective memory: (1) The formation of an intention to carry out the desired behaviour, (2) remembering the behaviour; (3) remembering when the desired behaviour needs to be undertaken; (4) remembering to undertake the desired behaviour; (5) carrying out the desired behaviour at the appropriate time and place and, lastly; (6) remembering that the behaviour has been performed. For an individual to effectively carry out a future intention each of those characteristics needs to be present. In prospective memory, there are two discriminative events that may occur; time-based or event-based (Schmitt, 2001).

An event-based discriminative event requires a specific setting stimulus to set the occasion for a particular intended response (Schmitt, 2001). In the event-based setting, an individual is required to perform a specific behaviour and this is often prompted by an external cue. For example, a child is required to give an excursion note to their parents when they arrive home from school. The behaviour in this setting is handing the note to the parent, and the cue is that the behaviour is to occur when the child arrives home from school. The second discriminative event in prospective memory is time-based. A time-based discriminative event requires an individual to perform a specific behaviour at a particular point in time (Schmitt, 2001). For example, a child might want to remember that their favourite

television show starts at 2pm, therefore they will have to remember to carry out the specified behaviour, watching their favourite television show, at the correct point in time of 2pm. Therefore, remembering to do things in the future is a common everyday memory task that is required of children of all ages.

Prospective Memory and Children

Research into prospective memory and children has grown steadily over the years. It has primarily focused on developmental effects, in particular, the age at which prospective memory skills emerge and whether or not children possess knowledge about appropriate strategies for completing prospective memory tasks in daily life (Kvavilashvili, Kyle, & Messer, 2008). A number of researchers have investigated event- and time-based prospective memory of young children using naturalistic tasks and laboratory measures. Of those tasks, computerised laboratory methods are used most often, with either event- or time-based prospective memory being examined, with only a small number of studies examining both forms of prospective memory together. A distinguishing feature of a number of tasks examining prospective memory is simplicity. Many of the tasks have not examined prospective memory with common daily activities that children would experience in their lives. For example, Aberle and Kliegal (2010) used a sand hourglass to investigate time-based prospective memory of children. The children in this study were required to turn the hourglass when the sand ran out whilst completing a game of memory pairs as the ongoing task. Although it was simple enough for young children to complete, it did not require them to complete a number of tasks nor did it require them to complete a variety of prospective memory tasks.

In addition, a common methodology used to examine prospective memory of children is the picture-naming task (Kvavilashvili et al., 2001). In this task, the participants are asked to name animals shown, one at a time by an experimenter, as pictures on cards. For the prospective memory task, the participants were asked to remember to hide the card under their chair when they saw a target picture (e.g. dog). A number of studies have used this methodology or similar to study prospective memory (Ford, Driscoll, Shum, & Macauley, 2012; Kliegel, Brandenberger, & Aberle, 2010; Kliegel & Jager, 2007; Mahy et al., 2011; Meachum & Colombo, 1977).

Of the laboratory-based tasks used for researching prospective memory of children, a number of researchers have used variations of a computer-based driving task, working/spatial memory computer tasks or virtual world. CyberCruiser and variations of this driving game have been used to study prospective memory of children. This time-based measure was designed to be ecologically valid and engages children in driving a car on a road through traffic using a joystick, with the primary goal being to gain as many points as possible by not hitting other vehicles (losing points) and passing other cars (gaining points) (Kerns, 2000). Further, the prospective memory task in the game requires the children to monitor the fuel level of the car. The duration of CyberCruiser is five minutes and the car runs out of fuel after one minute of play. Kerns and Price (2001) used the same methodology however increased the time of the game from 5 min to 8 min, in order to increase the number of prospective memory trials and outcomes. In this experiment, a simple event-based task was also included and participants were asked to perform an action, for example, getting up and opening a door, at a specified event during the experiment.

A criticism of the CyberCruiser game is that the time-based prospective memory measure of driving the car was stated as being ecologically valid (Kerns, 2000; Kerns and Price, 2001). The participants in each study were children between the ages of 7 and 12 years of age. Ecological validity typically refers to whether or not an individual can generalise an observed behaviour from the laboratory to the real world (Schmuckler, 2001). Therefore, if children are playing a driving game in the laboratory and completing PM tasks, this behaviour cannot be generalised to the real world because children do not know how to drive cars.

Talbot and Kerns (2014) used an adaptation of CyberCruiser (CyberCruiser II - Outer Space) to assess prospective memory of children with ADHD. In this version, participants earned points by piloting a spaceship through space and avoiding obstacles such as planets or comets. For the event-based task, the participants played Super Little Fisherman designed by Yang and colleagues (2011). In this computer game, the participants caught as many fish as possible and had to remember to feed the cat (clicking on it) every time a specific target fish was on screen (Talbot and Kerns, 2014). The ongoing task performance was measured by the total number of fish caught and the prospective memory measure was the number of times the children responded to the event-based prospective memory cue (Talbot et al., 2014).

Rendell and colleagues (2009) implemented a modified version of CyberCruiser, using a 3-D driving game. This game also required the participants to refuel a car, however this occurred only when a red light flashed and when a petrol attendant was displayed on screen. As with previous versions, prospective memory performance was measured as the number of times they correctly remembered to refuel the car. Similarly, Williams, Boucher, Lind and Jarrold (2013) implemented a driving game, but assessed both event and time-based

prospective memory. For the time-based condition, participants were told the car needed to be replenished within 80 seconds. For the event-based condition, the participants were instructed to press an 'H' key every time the car that they were driving passed a truck. Results showed that preschool and primary school aged children were able to perform the event-based PM tasks.

A number of researchers have used computerised working memory tasks, with a prospective memory task embedded. For all of these tasks, the participants complete an ongoing task and the prospective memory task simultaneously. Altgassen, Schitzhubsch, and Kliegel (2010) implemented a working memory task whereby the participants had to remember the location of symbols presented on the screen. The prospective memory task was undertaken at the same time and the participants were asked to press a coloured key whenever the background was a specified colour (e.g. yellow). A number of studies have implemented this methodology or similar variations with young children, with mixed results (e.g. Altgassen, Williams, Bolte, & Kliegel, 2009; Brandimonte, Filippello, Coluccia, Altgassen, & Kliegel, 2013; Guajardo & Best, 2000; Mackinlay et al., 2009; Smith, Bayen, & Martin, 2010).

Alternatively, Rendell and Craik (2000) created Virtual Week for the purposes of investigating prospective memory in the laboratory. They created a task that mimicked features of daily living, endeavouring to investigate a variety of PM tasks in daily life. Virtual week is a computerised board game and individuals move a piece around the board by rolling a dice. The times of the day that individuals are typically awake are marked on the board. Throughout a virtual day, participants make choices about daily activities and they are asked to remember to undertake these activities (prospective memory tasks). Virtual week has been used in a number of studies investigating prospective memory in clinical

groups (Foster, Rose, McDaniel, & Rendell, 2013; Henry et al., 2014; Mioni et al., 2013). Of these studies mentioned, all have found a deficit in event and/or time-based prospective memory of children.

Prospective Memory and Clinical Groups

Remembering future intentions is critical to the functional independence of clinical groups, for example, remembering to take medications or attend important appointments. Reduced prospective memory function has been demonstrated across a number of clinical groups including those with a Traumatic Brain Injury (TBI) (Kinsella, Ong, & Tucker, 2009; Mathias & Mansfield, 2005), Parkinson's Disease, Schizophrenia, and individuals with developmental disorders (Brandimonte et al., 2013; Kerns, 2000; Kerns and Talbot, 2014; Henry et al., 2014; Mahy and Moses, 2011; Williams et al., 2013; Williams et al., 2014; Yi et al., 2014).

TBIs are frequently associated with cognitive dysfunction and a number of researchers have found impairments in event- and time-based prospective remembering in patients with a traumatic brain injury (Kinsella et al., 2009; Mathias & Mansfield, 2005). Deficits in event-based PM have been observed when the individual was required to perform the task after a short interval, and for time-based tasks when individuals forgot to perform the intended behaviour after short and long intervals (Mathias & Mansfield, 2005). More recently, researchers investigating TBI have found that it is associated with poorer prospective memory functioning when using the 'Virtual Week' paradigm (Mioni et al., 2013). In particular, individuals with TBI are less accurate than controls on Virtual Week tasks, and the magnitude of impairments was consistent across the regular and irregular tasks (Mioni et al., 2013).

These results have been replicated in individuals with Parkinson's disease and Schizophrenia (Foster et al., 2013; Henry et al., 2007; Kliegel, Phillips, Lemke, & Kopp, 2005).

Attention Deficit Hyperactivity Disorder.

A number of researchers have also investigated the role of prospective memory in individuals with ADHD. Kerns and Price (2001) examined prospective memory of children with ADHD and normal controls. The researchers compared the children's ability to remember to fill a fuel tank whilst playing the virtual driving game 'CyberCruiser'. As previously mentioned, this game measures how many times the car runs out of gas during a 5-min period. When the data were reviewed, children with ADHD had more difficulty with a time-based task of prospective memory than typically developing controls (Kerns and Price 2001). In support of these findings, Talbot and Kerns (2014) also found that children with ADHD performed more poorly than typically developing controls on time-based PM tasks. In addition, they assessed event-based PM and found poorer performance on these tasks.

In contrast, Brandimonte and colleagues (2011) examined event-based prospective memory and response inhibition of children with ADHD. Participants performed an on-going task and had to remember to press a yellow space bar when the PM target appeared on the screen. Each prospective memory target was presented a total of 4 times (Brandimonte et al., 2011). Contrary to expectations, ADHD children showed a reverse pattern of previous results with participants having intact event-based prospective memory performance. Alternatively, Kerns and Price (2001) found no differences between ADHD and participants in the control group in event-based PM. The task was administered prior to the participants playing CyberCruiser, and they were asked to get up and walk over to

a door when the experimenter snapped their fingers. There were four tasks of a similar nature carried out consecutively in the experimental session. Performance in this task was at ceiling level, therefore the task might have been too easy for the participants with the majority of participants scoring 5 or more out of 8 in total correct responses. On the other hand, Brandimonte and colleagues' (2013) event-based task was difficult enough to ensure that potential differences in PM were observed.

Kliegel, Ropeter, and McKinlay (2006) explored complex prospective memory of children with ADHD. In order to examine complex PM the "Heidelberger Exekutivfunktionsdiagnostikum" (HEXE) was used. The HEXE is a computer-based task whereby the participants plan the delayed performance of different subtasks. The prospective memory task in this study required the children to remember to initiate the entire HEXE procedure by themselves, therefore they needed to turn the computer on and begin one of the subtasks. Second, the children had to remember to initiate the remaining three subtasks within a specified period. Contrary to expectations there were no deficits found in event-based prospective memory of children with ADHD, whilst the results were trending in the direction no significant effect was found. These findings are in contrast to previous significant results in this clinical group (Kerns & Price, 2001).

Autism Spectrum Disorder.

Although significant research has been undertaken in retrospective memory of children with autism, prospective memory has received relatively little empirical attention. Altgassen and colleagues (2009) were the first to investigate prospective memory of children with ASD using a classic PM paradigm. In this study, a visuo-spatial working memory task was used and a time-based PM task

was embedded. The ongoing task required the participants to remember a configuration of symbols displayed on a computer screen. For the prospective memory task, the participants were required to press a pink button every two minutes. Results from the study indicated that participants with ASD checked the time less often and showed a time-monitoring behaviour that was different to controls. In other words, controls increased their clock checks as the target times approached. Although this first study suggested a prospective memory deficit of children with ASD, inconsistent results have been found across a number of studies.

The main inconsistency in prospective memory research is whether or not there is a deficit in event-based prospective memory of children with ASD. Altgassen et al. (2010) studied event-based PM using a computerised task. The PM task required the participants to press a pink key whenever the background of the computer screen turned yellow whilst completing an ongoing visuo-spatial working memory task. Contrary to expectations, there were no significant differences found in prospective memory, the children with ASD performed as well as neurotypical controls in event-based PM performance. Furthermore, Henry et al. (2014) examined PM performance using Virtual Week. Their results showed significant impairments for the time-based tasks, however no significant impairments were found for the event-based tasks when compared to typically developing controls.

In addition, Williams and colleagues (2013) studied the role of executive function and event-based prospective memory of children with ASD using a computer-based driving game, based on that employed by Kerns (2000). The game required the participant to drive a car down the street whilst collecting gold tokens and avoiding obstacles and players were awarded points per token and they

were deducted points when they hit an obstacle. In the event-based condition, the PM instruction was to press the 'H' key every time the car they were driving passed a lorry truck. In support of Altgassen et al.'s (2010) findings, participants with ASD checked the clock as frequently as the comparison participants, whilst also exhibiting similar time monitoring behaviours throughout the task (Williams et al., 2013).

In contrast, a number of researchers have found a deficit in event-based prospective memory of children with ASD (Brandimonte et al., 2013; Jones et al., 2011; Talbot et al., 2014; Yi et al., 2014). Brandimonte et al. (2013) examined prospective memory and response inhibition of children with ASD. They found that the performance of children with ASD was significantly less accurate and slower than their typically developing peers. In addition, Yi and colleagues (2014) investigated prospective memory in regards to its cognitive correlates, with three main aims, a comparison of event-based performance of young children, the role of executive functioning, and the examination of the role of age and cognitive functioning. In support of the above research, children with ASD completed significantly fewer prospective memory tasks in comparison to typically developing children. Thus, the research reviewed above demonstrates support for a deficit in prospective memory performance in clinical groups.

Measurement of Prospective Memory

Over the years, measurement of prospective memory has been challenging with issues arising with the type and complexity of the ongoing task and the prospective memory tasks. A typical prospective memory paradigm consists of four major elements. First, the participants are engaged in an ongoing activity implemented in order to parallel the completion of tasks in the real world. Whilst engaged in the ongoing activity, the participant must remember to perform an

unrelated action at a specified point in time, or at or after a specified event during the experiment (McDaniel & Einstein, 2007). Second, participants are informed that they are to carry out a specific action whilst performing another task, for example, participants may be completing a computerised task and need to complete an action simultaneously. Third, in a typical PM paradigm participants are given some distraction prior to the start of the ongoing task so that they do not retain the prospective memory intention in working memory. Lastly, performance on a PM task is measured as the proportion of trials in which participants remember to execute the prospective memory task (McDaniel & Einstein, 2007).

A number of studies have measured PM with either a single, or multiple, response being required on a prospective memory task (Alberle and Kliegal, 2010; Altgassen et al., 2009; Altgassen et al., 2010; Brandimonte et al., 2013; Kerns et al., 2000; Kliegal & Jager, 2007; Mahy et al., 2011; Talbot et al., 2014). These methods of assessment are restricted in their range of outcomes due to limited variability and problems with reliability and validity. Alberle and Kliegal (2010) used a simple task to investigate time-based prospective memory. Children completed a game of memory pairs and whilst playing the game they were required to monitor sand in an hourglass. Whenever the sand ran out, the children had to remember to turn the hourglass, with the maximum of six turns being required. This methodology is restricted because the children completed only one form of a prospective memory task (turning the hourglass), requiring little performance variability. Kliegal et al. (2007) examined prospective memory in pre-schoolers who were required to place a particular target card in a box beneath their chair whilst completing a number of drawings on paper (the ongoing task). This study included only three opportunities to complete the prospective memory tasks, therefore limiting the number of correct responses in the experiment.

Although the children in the sample were young, the experiment did not adequately address prospective memory across a number of different trials, and across a variety of prospective memory tasks.

Researchers have also used picture-naming tasks to investigate prospective memory of children (Ford et al., 2012; Kvavilashvili et al., 2001; Mahy et al., 2011; Yi et al., 2014). As previously explained, the children are engaged in a simple laboratory task, whereby they name a series of picture cards, which constituted the ongoing task in the experiment, and they were required to remember to hide a card if they saw a picture of the target animal for the PM task. In these experiments, there are four stacks of cards, with one target card in each, therefore, the children had four opportunities to perform the prospective memory task. Contrary to the views of the researchers, these methodologies do not adequately capture the most important features of prospective memory in everyday life. They fail to test children in completing tasks that are contextually relevant to them, for example, putting their lunch box away, or remembering to wash their hands before morning tea. Tasks like naming a picture on a card and remembering to place a target card in a box is not an adequate way of measuring prospective memory due to the simple nature of the task.

Not only have there been issues with the simplicity of the prospective memory task itself, there have also been issues in establishing ongoing tasks. Some tasks have not been challenging enough resulting in ceiling effects occurring or they have been too difficult for the participants to complete (Altgassen et al, 2009; Kvavilashvili, Messer, Ebdon, 2001, Mahy et al., 2011). Altgassen and colleagues (2009) conceded that the visuo-spatial working memory task used as the ongoing activity in their study was too difficult for both the control group and the children with ASD. In this task, the participants were

presented with geometric shapes (e.g. green square) on a computer screen, after an inter-stimulus interval of a black screen, the symbols reappeared and the participants had to respond via key press whether or not the symbols presented were in the same location. For adequate measurement of prospective memory, it is important that the ongoing task implemented is not too difficult for the participants as this may give rise to poorer performance on the PM tasks due to the allocation of attentional resources towards the ongoing activity, not the challenge of the PM task itself. Further, the same goes for an ongoing task that is too easy (Kvavilashvili et al., 2001), this gives rise to at-or-above-ceiling performances on PM tasks and therefore this does not effectively measure PM.

To address previous methodological constraints of single-trial designs, Kerns and colleagues (2000) designed a naturalistic and engaging computerised task called 'CyberCruiser'. As previously mentioned above, the game includes five repeated time-based prospective memory tasks and there is no requirement for the knowledge of clocks. This task has been used as a measure of prospective memory in a number of studies (Altgassen et al., 2010; Kerns et al., 2001; Talbot and Kerns, 2014). However, CyberCruiser is limited in its measurement of prospective memory due to the use of only a single PM task requiring multiple responses. For example, Kerns (2001) and Talbot and Kerns (2014) measured performance by the number of times the virtual car ran out of gas. In a short experimental procedure, the participants with ADHD ran out of gas 3 times in comparison to the control group who ran out of gas only once. These studies were restricted in their range of outcome and limited variability of the prospective memory measures implemented.

From the research reviewed, it is clear that there are a number of methodological issues when it comes to studying prospective memory. One

prospective memory task that overcomes these challenges is Virtual Week created by Peter Rendell (2000). Virtual Week is a computerised board game that was developed to closely represent prospective memory tasks in daily life. This laboratory task simulates daily life with the participants moving around the board and they are required to make choices about daily activities, for example, what they will eat for breakfast. They are also required to remember to carry out a number of lifelike activities in the form of tasks. These tasks endeavour to test the prospective memory of the participants, for example, are the participants able to remember to take their medication in the morning.

One of the key features of Virtual Week is that prospective memory performance can be investigated systematically in regards to the different PM task parameters (event-based versus time-based tasks) and the retrospective memory demands with the regular versus irregular tasks (Foster et al., 2013; Mioni et al., 2013; Henry et al., 2014). Virtual week also has excellent reliability and validity (Henry et al., 2007; Rose, Rendell, & McDaniel, 2007). As stated previously, no other methods of studying prospective memory have included a large number of tasks, whereas virtual week includes eight prospective memory tasks in one day. These tasks also vary in their task demands occurring on regular or an irregular basis. This gives rise to a broader range of measurement, allowing for a larger degree of prospective memory to be measured. For example, there are 8 prospective memory tasks presented in each virtual day. If a participant remembers consistently 4 regular tasks each day, the researcher can devise a plan to improve strategies to remember the irregular tasks, such as reminders etc. In simple methodologies, this would not have been possible due to the restricted scale of measurement.

In the methodologies reviewed, prospective memory is either evident or not evident and they do not show how accurate an individual's prospective memory is or how much of a deficit that they may have in certain task areas. However, Virtual Week can show the researcher more precisely where the deficit lies in an individual's prospective memory performance. In addition, Virtual Week differentiates between time- and event-based tasks in each virtual day. The vast majority of the prospective memory research reviewed only investigated one of these types (either event or time-based) and not both forms successively. Given the discussion above, Virtual Week was the methodology of choice due to its reliability and validity when used with clinical groups and also for its variation in prospective memory task requirements.

Positive Reinforcement, Reward, and Memory

Positive reinforcement increases the likelihood of behaviour it follows. It can increase the chances of compliance with requests when complying leads to a reinforcer. In regards to the behaviour of 'memory', it is a common false belief that cognitive events cannot and should not be studied by behaviour analysts (Baltruschat et al., 2011). This is because mental or cognitive events are considered private behaviours and therefore cannot be studied outwardly. However, anything that an individual does when interacting with their environment is a behaviour whether it be overt or covert. It is assumed, therefore, that the behaviour is amenable to change through a variety processes such as learning and motivation (Baltruschat et al., 2011).

A small number of studies have investigated the role of reward and positive reinforcement in memory of children. Meacham & Singer (1977) were the first to investigate the role of incentives and reward in prospective memory was by They examined the relationship between high and low incentives in

prospective memory task completion and whether or not task regularity played a part in the prospective memory of university students. They found that even with a moderate incentive there were increases in prospective remembering (Meacham & Singer, 1977). This result was obtained regardless of whether or not the task was to be completed on a regular basis. Therefore, they concluded that motivation and reinforcement are perhaps critical in the theoretical analysis of prospective memory.

Not only has reward and memory been studied in adults, investigations have also been conducted on children. Guajardo and Best (2000) applied incentives in their study to change prospective memory behaviours of young children. Specifically, the researchers wanted to investigate the incentive effect and if children could improve on event-based prospective memory tasks when they received a reward. Contrary to expectations, mixed results were found and receiving a reward for accurate responding on the computer tasks did not increase the likelihood of the children responding correctly to the prospective memory task (Guajardo et al., 2000). Furthermore, Kliegel and colleagues (2010) investigated the role of motivation on the prospective memory performance of preschool children. Children between the ages of 3 and 5 years were required to perform a prospective memory task in either a high- or a low-motivation condition. In the high-motivation condition, the children were asked to remind the experimenter to give them a present from the 'magic box' once they had completed their task (Kliegel et al., 2010). In the low-motivation condition, the children were required to remind the experimenter to write their name down after finishing the task (Kliegel et al., 2010). In line with Guajardo and Best (2000), no significant effects were found when reinforcing accurate prospective memory performance.

Although the above research demonstrated mixed results, the comparison of

prospective memory occurred across groups of children. The researchers did not investigate individual differences among the children within each group, thus the performance of each child in the experiment was not assessed. During reinforcement, individuals perform variably for different reinforcers, in that what is reinforcing and motivating for one individual may not be reinforcing or motivating for another, therefore, it is important to assess this change at an individual level rather than a group level.

In contrast, Baltruschat and colleagues (2011a) addressed working memory at an individual level, for children with ASD through a behavioural intervention using positive reinforcement. Participants completed the Arbeitsgedächtnis Testbatterie (AGTB) which comprises six subtests including (1) Complex Span, (2) Colour Span, (3) Digit Span Backwards, (4) Stroop-like, (5) Go/No Go and (6) Counting Span (Baltruschat et al., 2011a). The counting-span task was used as the primary measure of memory abilities in this study. During this task the participant was required to count circles mixed with other shapes in a series of arrays. They were required to state the quantity when each array was presented and recall the correct order in which they were presented (Baltruschat et al., 2011a). In order to implement positive reinforcement, each child was asked to select a highly preferred item from an array. The child was told at the beginning of the experiment that for every correct response they would be gain access to their highly preferred item for a period of 1 min (Baltruschat et al., 2011a). The Baseline phase was undertaken in order to increase accuracy on the counting span task and to determine the number of cards that needed to be presented to produce low levels of accuracy. After each successive trial, a new flashcard was added until consistent poor accuracy was determined. Positive reinforcement was given for each correct response in the counting task and the

children were given access to their highly preferred item. Results from the study indicated that a basic behavioural intervention can be employed to improve the working memory abilities of children when using a counting span task (Baltruschat et al., 2011a). This study provides support for the idea that behaviour analysts can reinforce the behaviour of remembering.

In a further analysis of the effects of positive reinforcement on memory of children Baltruschat et al. (2011b) employed a complex span task from the subtest of the AGBT. The distractor task in this study required the participants to answer questions that needed a classification response, for example “Can you eat it?” or “Can you wear it”. Baseline data were taken prior to intervention, and the participants rehearsed the task with the investigator twice before beginning. Similar to the previous study, when positive reinforcement was implemented alone it was effective for 2 of the 3 participants, however, explicit prompting and reinforcement of rehearsal was required to bring accuracy up to high levels for one participant. The results therefore do suggest that mediating the behaviours through positive reinforcement is sometimes necessary to improve working memory performance (Baltruschat et al., 2011b).

To my knowledge, Baltruschat and colleagues (2011a; 2011b) are the only researchers that have completed a behavioural intervention on memory itself. It is imperative that further study be undertaken on memory in this manner, because behavioural interventions allow researchers to change the prospective memory behaviours of children. Children with ASD are thought to have deficits in executive function (Hill, 2004; Kenworthy, Yerys, Anthony, Wallace, 2008) and specifically prospective memory, however the research reviewed only assessed the deficits in prospective memory of children. There is no research that provides strategies or alternative interventions to improve the memory performance of

children with ASD. Therefore, if a behavioural intervention can be implemented, then strategies can be devised to improve and maintain this behaviour among these children.

First, I aimed to assess the prospective memory abilities of each child when completing virtual week. My second aim was to investigate if reinforcing the prospective remembering of children with Autism Spectrum Disorder increased the probability of those behaviours occurring again. I hypothesised that by reinforcing the behaviour of remembering and completing a prospective memory task at the appropriate time or event, there would be an increase in the probability of that behaviour occurring again in a similar setting.

To my knowledge, there have been no replications of research with Virtual Week with children younger than 8 years of age. Further, there have been no studies investigating the role of positive reinforcement in prospective memory of children. My aim was to use Virtual Week with children who have ASD between the ages of 6 and 7, providing positive reinforcement for prospective remembering.

Method

Participant Selection

I selected participants from a mainstream primary school in Sydney, Australia. Children from Kindergarten to Year 6 attend the primary school. The majority of children at the school are typically developing, with a small number being of high needs and having additional support. I was employed at the primary school at the time of the study and I approached the principal to gain approval to find participants. The school newsletter featured an advertisement (see Appendix A) every fortnight for the duration of Term 2, 2015. To gain participants from other schools, I also placed the advertisement on the Applied Behaviour Analysis

Directory Facebook page. This page is strictly for families of children with ASD and Applied Behaviour Analysis (ABA) therapists in Sydney and Melbourne. I invited parents to contact me to discuss further details of the study and gave them an information sheet (see Appendix B). From the information sheet, I gathered further details about the children to ensure that they met the conditions for entry. I recruited children whose parent/s or guardian/s consented for them to be in the study, and who were in Year 1, between the ages of 6 and 7, and who had a diagnosis of Autism Spectrum Disorder. If the child met the criteria, I discussed the study with the parents and gave them an opportunity to ask further questions. The parents/guardians were given a consent form (see Appendix C) to be signed to allow their children to participate. The days and times of the experimental sessions were then organised with each parent to suit him or her.

Participants

Four children between the ages of 6 and 7 years participated. Children 1 and 2 were identical twin boys and their mother reported that both boys had a diagnosis of ASD. They both attended a mainstream primary school in Sydney, and had assistance from a number of teacher aides. The boys had received intensive behavioural intervention services for approximately 5 years, but at the time of the study, neither child was receiving any behavioural intervention services.

Child 3 was diagnosed with ASD in June 2013 when he was 4 years old, received a diagnosis of ADHD in February 2014, and was subsequently prescribed Ritalin. He had never received intensive behavioural intervention services.

Child 4 was diagnosed with ASD in August 2012. He received speech therapy from the age of four, which was discontinued in July 2015. He had not

received intensive behavioural intervention services and attended a mainstream preschool from 2012.

Setting

All sessions were conducted in a quiet room in the participants' homes. Session length ranged between 45 - 60 min for each participant. The parent/guardian of the participant and I were present for the duration of each session.

Materials

Virtual Week is a computerised board game that simulates daily life and was originally developed by Rendell and Craik (2000). The board contains 122 squares representing times from 7am to 10pm (Figure 1). The day of the week and the time of the virtual day are marked in the centre of the board and each circuit represents one virtual day. On the board are 10 event squares evenly spaced around the board (marked in green). The participants need to 'click' the event card when they land on or pass an event square. When the event card is open, a screen pops up and gives a brief description of a daily activity and three options related to that activity. For example, participants might be asked to choose their preferred option for breakfast such as "*You have toast for breakfast. The only spread available is smooth or crunchy peanut butter*".

Do you have?

- Crunchy peanut butter
- Smooth peanut butter
- Plain buttered toast

After choosing one option, the participant can roll the dice again and move around the board. The activities on the event cards are designed to be relevant to an actual school day, with additional ordinary daily activities also included.

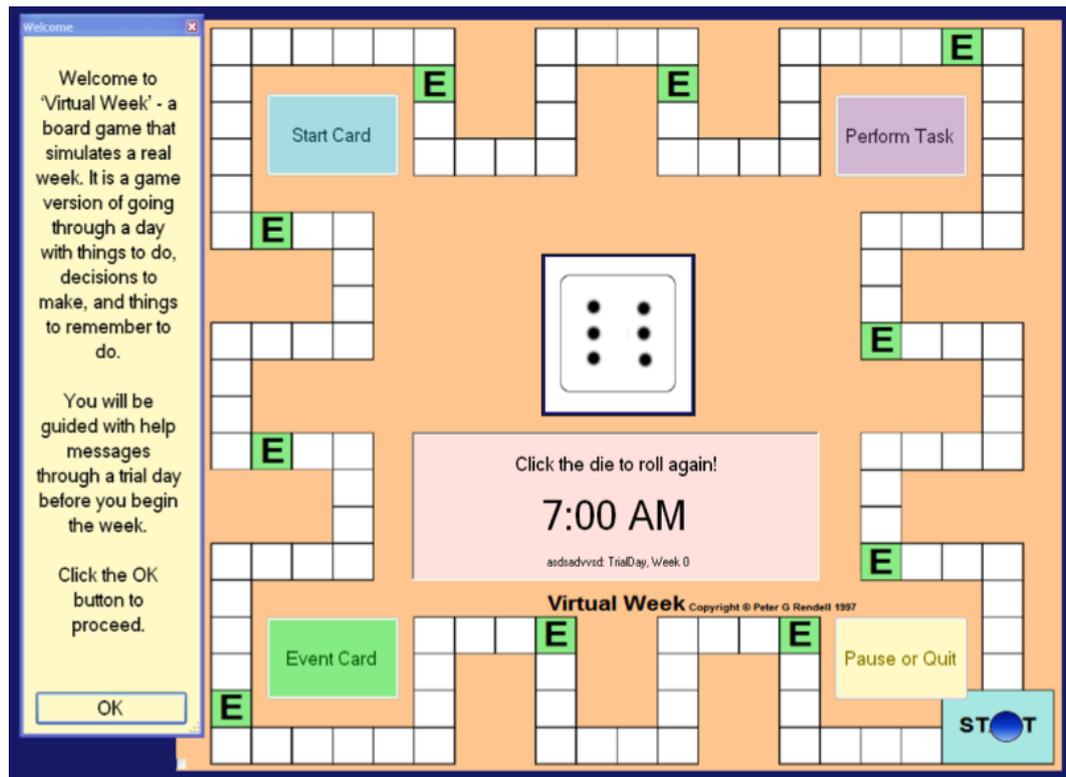


Figure 1. Computerised image of Virtual Week as presented on a PC.

For the prospective memory tasks, the participants needed to remember four regular and four irregular tasks for each virtual day. The regular tasks were two time- and event-based health tasks. The time-based regular task was taking an asthma puffer at 11am and 9pm each day. The event-based regular task was taking antibiotic medication at breakfast and at dinner. These tasks were outlined at the beginning of each virtual day by the “start card” and they were the same for each virtual day presented. By contrast, four irregular PM tasks (time- and event-based) were shown during each day. A critical feature of these tasks is that the participants are informed throughout the game and all of the tasks presented are different. An example of the irregular prospective memory tasks presented in virtual week are in Appendix D for event-based and Appendix E for the time-based tasks.

The Virtual Week version I used was adapted from Henry et al. (2014). I kept the overall task requirements the same and the participants completed eight PM tasks per virtual day. I adapted the daily event cards that the participants completed to simplify the language to be more applicable to the participants. For example “*You have a special art exhibition at school: during the exhibition you:*” was changed to “*You have an art show at school: During the show you*”. For the regular event health tasks (taking antibiotics), this was altered to read ‘tablets’ to suit the language abilities of the sample. In addition, I replaced some events with other events that occur at the school of the participants, for example, attending church, assembly, and library.

The ongoing task for this experiment required the participants to roll the die, pick up the event cards and engage in distractor activities. Whilst participating in the ‘ongoing task’ (playing the game) participants must temporarily disengage in order to execute the intended behavioural response to the PM tasks (Henry et al., 2014). Because my design implemented a behavioural intervention, I required extra “Virtual Weeks” in order to carry out the experiment (See Appendix F).

Participants viewed the Virtual Week board game on a laptop PC monitor and responded using the keyboard. Participants clicked the mouse to roll the die, read aloud the event cards, and made decisions about the daily activities.

Research Design

Individual differences in prospective memory performance were expected among the participants, therefore I used a single-subject ABC design to evaluate the effects of the intervention at the level of the individual child. The “A” represents the baseline (non-treatment) phase, and “B” refers to the intervention phase, during which the participants received positive reinforcement for correct

responses to the PM tasks. The last phase “C” is the maintenance phase to evaluate whether the target behaviour changed since the intervention phase.

Dependent Measure

I measured the proportion of correct prospective memory responses and scored the responses in six categories; correct, little late, late, little early, early, and missed. The definitions of each of these are shown in Table 1.

Table 1

Scoring of Response Categories reproduced from Rendell and Craik (2000)

| Response Label | Timing |
|----------------|--|
| Correct | Task is performed at the correct time or at the correct Event Card (i.e., after the die roll for the move that took the token onto or past the target square and before the next roll of the die). |
| Little Late | Tasks remembered after the correct criterion but before the next Event Card for event-based tasks and before one hour has passed (time-based). |
| Late | Responses made after the little late criterion and before the end of the virtual day. |
| Little Early | Responses are those made before the correct time and after the little late criterion. That is the previous Event Card for the event-based tasks and one hour before the expected time for the time-based tasks |
| Early | Those made before the little early criterion and after the start of the virtual day. |
| Missed | The participant did not remember the target item at any time. |

The categories in Table 1 apply to each PM response; regular event, regular time, irregular event, and irregular time and they are presented as a total number of responses per virtual day and as the proportion of PM tasks performed

correctly per virtual week in the results.

Procedure

I knew Children 1, 2, and 4 but not Child 3. Prior to beginning my first research session with him, I introduced myself and asked him what his three favourite games to play were. We chatted for approximately 5 minutes, with Child 3 asking me questions like “How old are you?” and “What games do you like to play?” After this, Child 3 was introduced to the Virtual Week board game. For the remaining participants, I greeted each child and their parents prior to the beginning of each session. I asked how their day at school went and I also asked each participant to tell me their favourite thing that they did at school that day. Once the greetings were completed, we went to a quiet room in the house and sat at the table to set up Virtual Week. The parent/guardian for each child sat at the back of the room for the duration of each session.

Baseline Phase.

To begin, I introduced the participants to the Virtual Week board game and informed them about the purpose of Virtual Week. Participants then completed a trial day and, during this day, I explained the game, the procedure, and answered any questions the children or their parents asked. I advised the participants about the different kinds of choices they could make in completing daily activities and how they could go about remembering to do the tasks throughout the virtual day. Before starting each virtual day, the participants read aloud the start card, which indicates what day of the week it is. I told them to inform me at the correct time that a task was to be completed and to inform me even if they were late in completing a task.

For baseline testing, Children 1 and 2 completed three virtual days, and Children 3 and 4 two virtual days. I gave no feedback to any child as to whether

their response was correct or incorrect. As the children failed to make any correct responses, baseline was discontinued, and the positive reinforcement phase commenced.

Positive Reinforcement Phase.

Prior to the beginning of each positive reinforcement session, the parents gave me a list of the top four proposed reinforcers for each child. This was repeated before each session to ensure that the children did not satiate on reinforcers and were given the opportunity to earn a variety of items throughout the experiment. At the start of the sessions, I showed the participants the reinforcers that they could choose from an array of four (e.g., edibles, iPad tokens). I also showed the participants a token board, “Rewards for Remembering”, which was placed beside the laptop computer (See Appendix G). If the iPad was chosen as a reinforcer, tokens were used for the children to earn throughout the game. If the child chose iPad time, they were able to pick a token up from the array and place it on the token board, with each token worth 2 min of iPad time. For the edible reinforcers, all children were offered the opportunity to have their reinforcer either straight away or after they completed each virtual day. If they chose to wait, the edible reinforcer was placed on the token board until the end of the virtual day. Not only did each child receive an edible/tangible reinforcer for every correct response, they also received social reinforcement. Social reinforcement can be very powerful and influences our behaviour in everyday life (Harris, Wolf & Baer, 1964). Reinforcement was in the form of verbal praise for each correct response, for example “Great job at remembering (insert child’s name)”. All of the items presented were items that the participants had restricted access to. I asked the participants’ parents not to allow access to these items outside of the experiment.

I told the participants that their Virtual school week would be busy, however, they would be rewarded for remembering to carry out specific tasks during each day. When each participant completed a PM task at the correct time or event they informed me immediately. The participant then chose their reinforcer from the array and placed it on the token board (or consumed the edible). By placing the reinforcer on the token board each participant could see how many items they were able to receive each virtual day for remembering the tasks correctly. After each virtual day, I placed the reinforcers earned in a clear plastic zip lock bag labelled with the child's name. This bag was placed in full view of the participant. I did not signal to the participants when they had missed a task.

To record each prospective memory response and to ensure correct reinforcement delivery, I had a printed version of the daily task event options for the virtual days to be completed (see Appendix H). When the child completed a task, I recorded the response by hand, correct responses were ticked off and all other responses received a cross on the daily task event options sheet. The children were unable to see the daily task event options sheet and the recordings being made. The computer also recorded results from each virtual week day within the Virtual Week game. To conduct a reliability check, I cross-referenced the data that were recorded by hand and within Virtual Week at the end of each session. Due to the study design and the different skills of each child, the number of virtual days completed in each session varied from 3-7 days. Table 2 below shows the number of virtual days for each child.

Table 2

Number of Virtual Days Completed in Each Phase

| Child | Baseline | Positive Reinforcement | Maintenance |
|-------|----------|------------------------|-------------|
| 1 | 3 | 12 | 3 |
| 2 | 3 | 15 | 6 |
| 3 | 2 | 12 | 7 |
| 4 | 2 | 16 | 6 |

Maintenance or Prompt Phase.

I visually inspected graphed data to determine whether positive reinforcement resulted in stable increases of correct responding on the prospective memory tasks. For prospective memory performance to be considered stable, I each child needed to remember at least 6 out of 8 tasks for a minimum of five virtual days during the positive reinforcement phase. If they did, I exposed participants to the maintenance condition. This condition was identical to baseline and I gave the participants no reinforcers for a correct response and no feedback as to whether they performed the tasks at the correct time or event during virtual week. If the participants did not meet criteria, the prompt phase was implemented. In this phase, an in-game prompt was introduced at a specific time during the game. This prompt was in the form of a to-do list, reminding the participants of the tasks to be completed for that virtual day.

Follow-up sessions were conducted one week after the end of the positive reinforcement phase for Child 1 (Prompt Phase), Child 2 and 4 and at 4 weeks for Child 3. Children 1, 2, and 4 were warned at the start of the session that no reinforcers would be received. Child 3 demonstrated some minor behavioural issues throughout the positive reinforcement phase, so it was decided that a social

story was needed to adequately prepare him for the maintenance phase. A social story is a short, visual description of a particular event or situation. They include specific information about what to expect in the situation/event, and help the child to learn how to respond or behave in that particular situation. Child 3's parents created and implemented the social story prior to my arrival for the maintenance session (see Appendix I for an example of the social story used).

Results

Pattern of PM Responses

The first four figures below depict the number of correct prospective memory responses made by Children 1, 2, 3, and 4 during baseline, positive reinforcement, and maintenance (or prompt) phases. The dashed vertical lines separate the data from the various phases and indicate a change in treatment. The responses were scored across six categories as described in Table 1 (Correct, Miss, Little Late, Late, Little Early, and Early).

Baseline Phase.

Child 1 (Figure 2), Child 2 (Figure 3), and Child 4 (Figure 5), did not achieve any correct responses in the baseline phase, with all prospective memory tasks missed or late for each virtual day. Children 1 and 2 completed 3 virtual days with no correct responses. Child 4 completed 2 virtual days with no correct responses. Child 3 completed 2 virtual days and he responded once to an irregular time-based task (little late). Accurate responding from the participants did not improve in the baseline phase and the positive reinforcement phase was initiated.

Positive Reinforcement Phase.

Positive reinforcement produced an increase in accuracy of PM responses for all participants. From the beginning of this phase, all participants showed a decrease in missed responses and an increase in correct responses to the PM tasks.

There were also increases in little late, little early, late, and early responses when positive reinforcement was introduced. During this phase, Child 1 chose to eat his edible reinforcers throughout the game. He placed his reinforcer on the token board, and then asked me if he could eat it straight away whilst completing his remaining virtual days.

Child 1's correct responses increased from baseline, but remained variable after 13 game days (Figure 2). With no clear upward trend, I decided, following visual analysis, to add in an in-game prompt. The in-game prompt was a to-do list of the irregular and regular event tasks for that day that was shown at a specific time during the virtual day (1pm).

Child 2's performance in the reinforcement phase showed an immediate change in the level of PM responses and he correctly responded to more virtual week tasks. Over the virtual days with positive reinforcement, Child 2's correct performance improved steadily, and, with some variability, he achieved increasing numbers of correct, late, little early and early responses. The correct responses increased and incorrect responses decreased (Figure 3). Child 2 correctly responded to all 8 tasks on Day 14 and 17 during the positive reinforcement phase. Responses during the positive reinforcement phase were better than the responses in the baseline phase. Child 2 chose to consume his edible reinforcers at the end of each reinforcement session.

Child 3 showed an immediate change in the accuracy of correct PM responses when positive reinforcement was introduced. His responses followed an upward trend and, demonstrated an increase in all task responses, responding to tasks either a little early, early, little late, and late (Figure 4). A downtrend is visible for his missed PM responses decreasing to zero on Day 8. Child 3 demonstrated that he could remember at least 6/8 tasks for 6 virtual days during

his reinforcement phase. He did not reach the maximum of correct responding (8/8) during the positive reinforcement phase. Responses during the positive reinforcement phase were better than the responses in the baseline phase. . Child 3 chose to consume his edible reinforcers at the end of each reinforcement session.

Child 4's performance on the prospective memory tasks increased immediately during positive reinforcement and demonstrated a clear upward trend for his correct responses (Figure 5). Over the virtual days with positive reinforcement, Child 4's performance improved steadily, with some variability in responses. He achieved increasing numbers of correct, late, little early, and early responses. Throughout the positive reinforcement phase, Child 4 averaged 6/8 correct PM responses and reached the maximum of correct responding on Day 10. Responses during the positive reinforcement phase were better than the responses in the baseline phase, Child 4 also chose to consume his reinforcers at the end of each reinforcement session.

I visually inspected the graphed data to determine which participants would move into the maintenance phase. Child 1 demonstrated variable performance and I decided to introduce an in-game prompt to improve his prospective remembering. Child 2, 3 and 4 demonstrated consistent responding on the prospective memory tasks, remembering at least 6 out of 8 tasks for a minimum of 5 virtual days during positive reinforcement and therefore they moved into the maintenance phase.

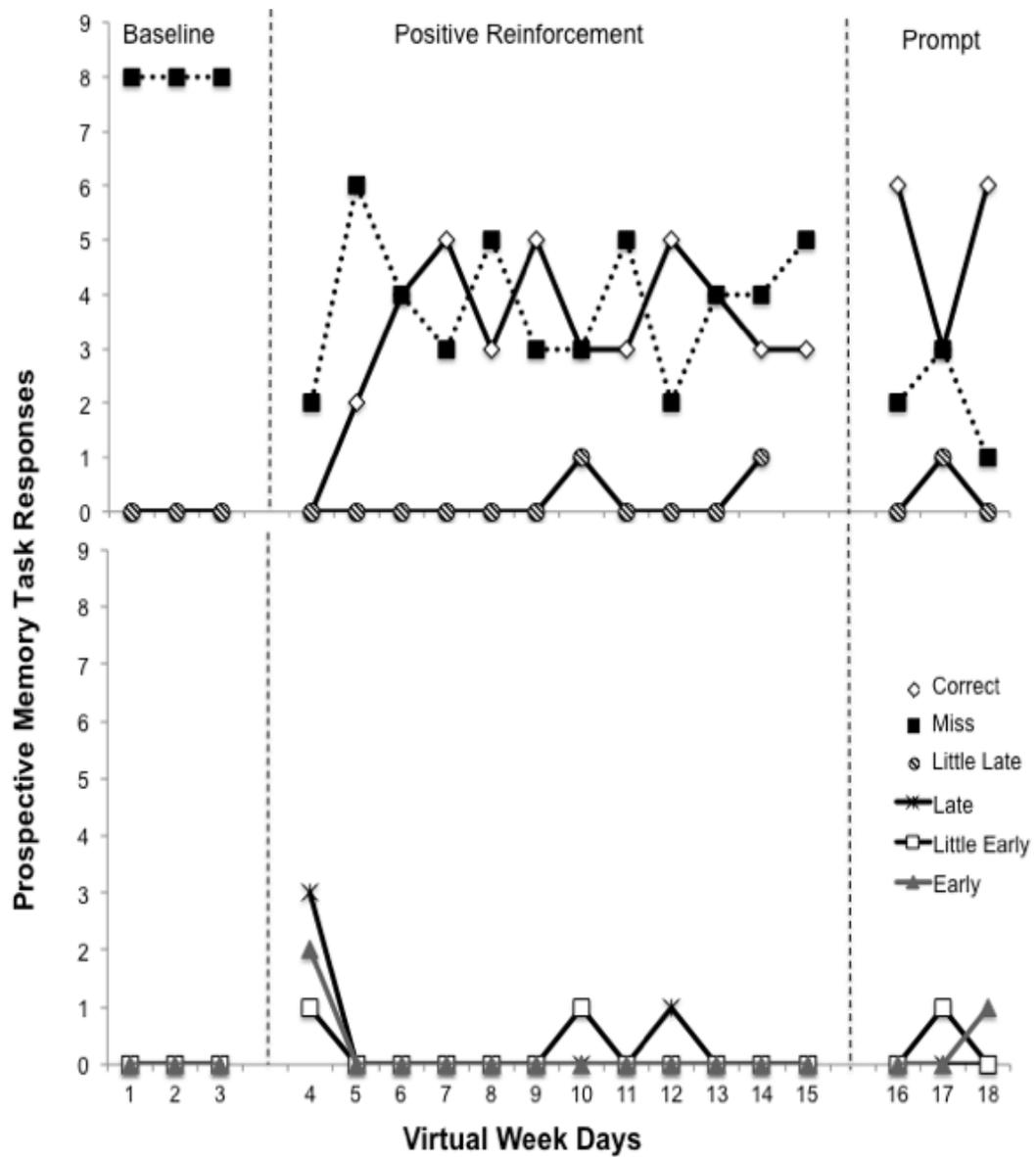


Figure 2. The number of prospective memory responses for each virtual day during baseline, positive reinforcement, and prompt phases for Child 1.

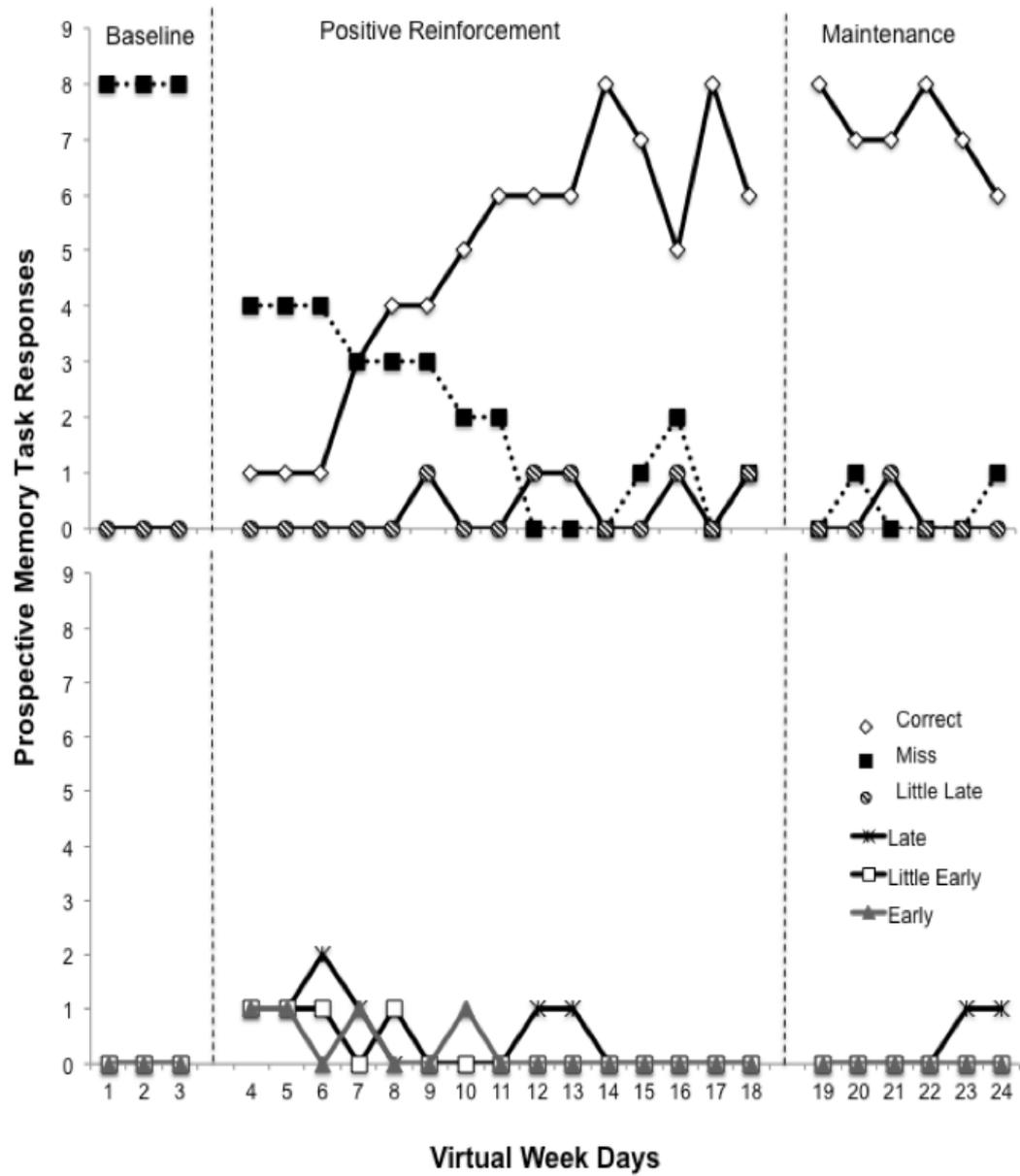


Figure 3. The number of prospective memory responses for each virtual day during baseline, positive reinforcement, and maintenance phases for Child 2.

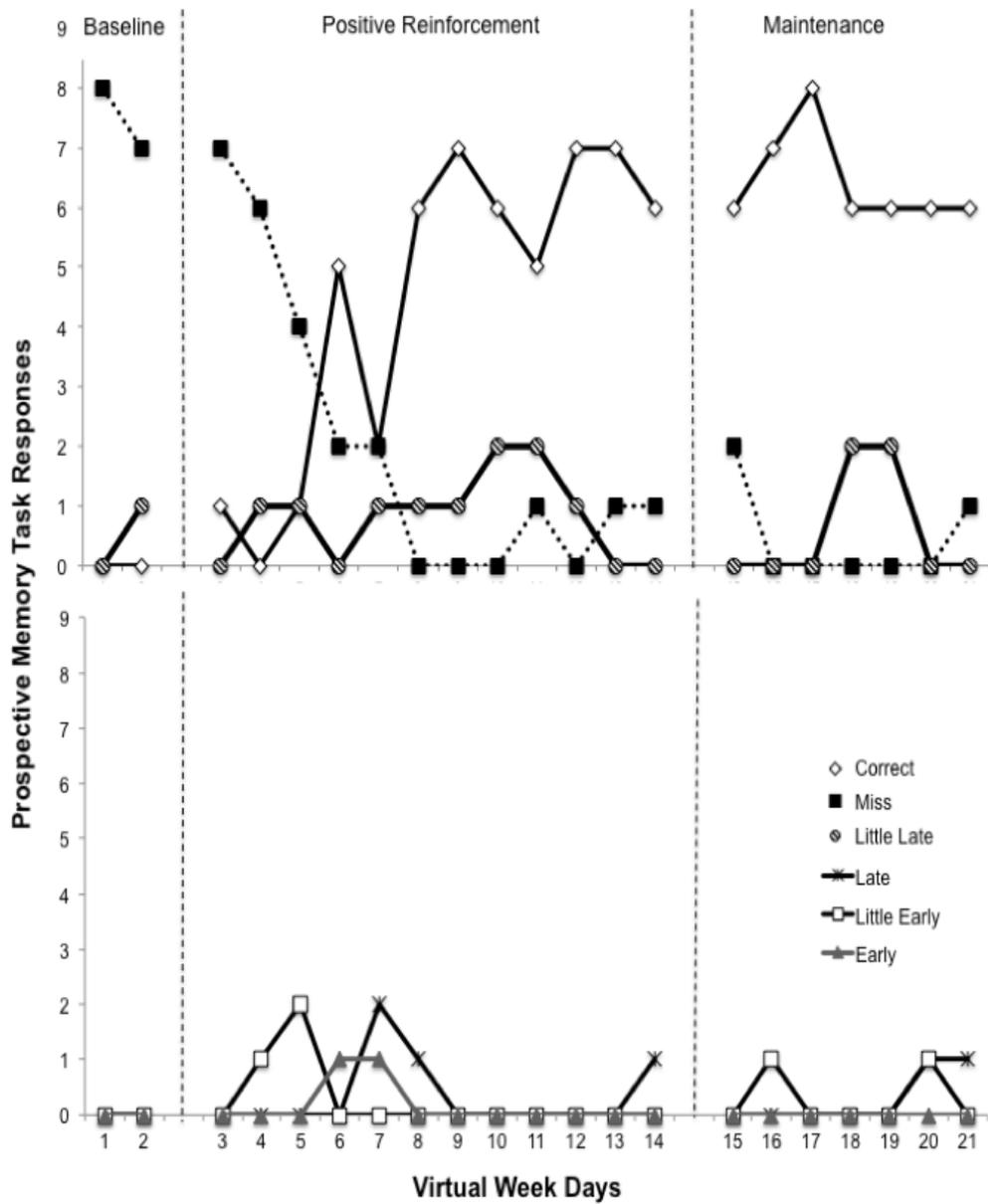


Figure 4. The number of prospective memory responses for each virtual day during baseline, positive reinforcement, and maintenance phases for Child 3.

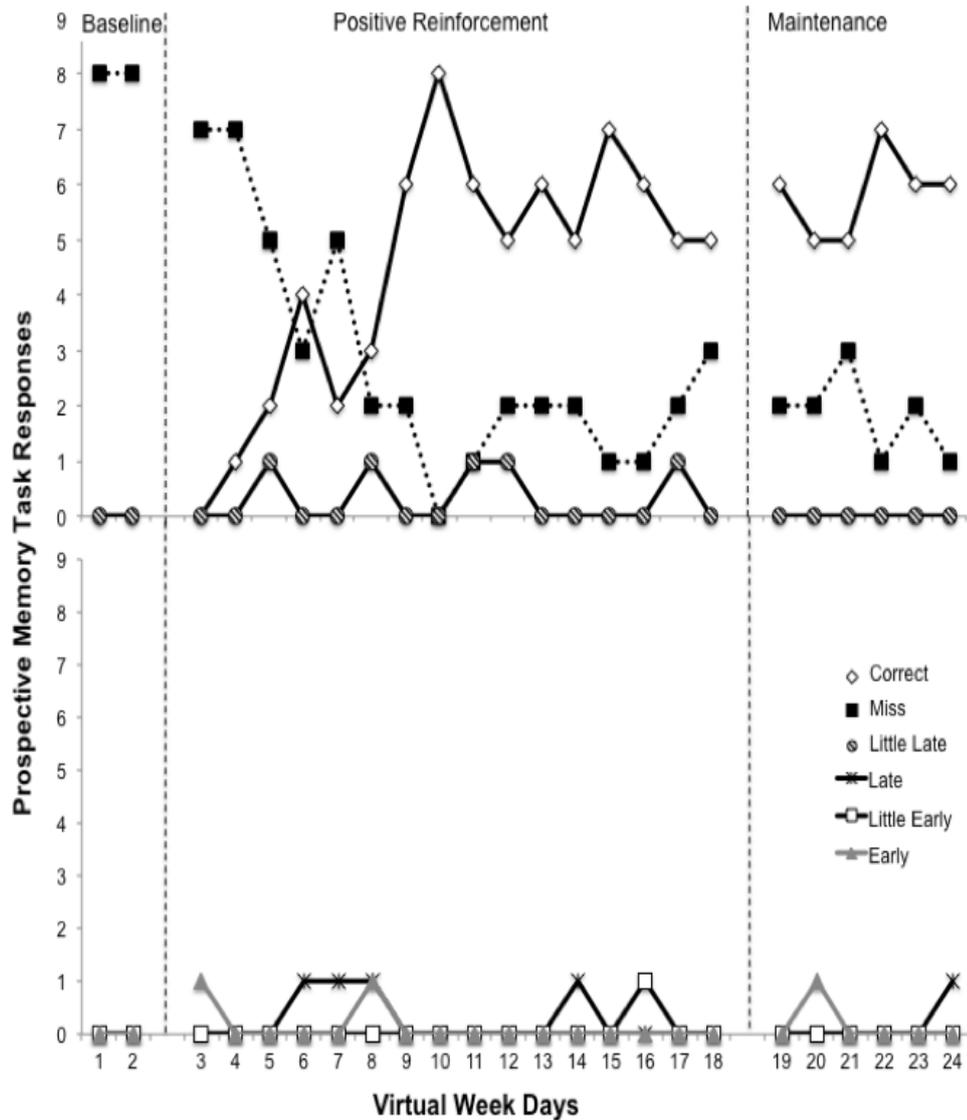


Figure 5. The number of prospective memory responses for each virtual day during baseline, positive reinforcement, and maintenance phases for Child 4.

Maintenance or Prompt Phase.

I conducted follow-up sessions 1 week after the end of the positive reinforcement phase for Children 1, 2, and 4 and at 4 weeks for Child 3. Following the introduction of the in-game prompt, Child 1's performance improved, and the number of correct prospective memory responses across all tasks increased. He remembered 6/8 tasks for 2 virtual days with the in-game prompt. Child 1 chose to complete his participation in the experiment on Day 18.

The three remaining children in the maintenance phase demonstrated correct responding to the PM tasks with no considerable difference in prospective remembering performance to the positive reinforcement phase. Child 2's performance in the maintenance phase stayed at same level as the positive reinforcement phase, with correct responding remaining relatively stable. However, there is some evidence that at the end of the maintenance phase, Child 2's accuracy was decreasing (Figure 2). Child 3 responded accurately in this phase, and his responding was similar to the positive reinforcement phase. His correct responses remained relatively stable for the duration of the maintenance phase, responding to 6/8 tasks for 4 virtual days. Child 4's performance in the maintenance phase was higher than the baseline phase, responding correctly to more PM tasks. His responses in the maintenance phase stayed at the same level as the positive reinforcement phase, with some variability in responding.

PM Accuracy: Proportion of PM Tasks Performed Correctly

Participants' PM performance can also be examined in terms of the proportion of correct responses for regular and irregular PM tasks as a function of event- and time-based tasks. Figures 6, 7, 8, and 9 present the proportion of correct responses during each Virtual Week for Child 1, 2, 3, and 4 during the baseline, positive reinforcement, and maintenance or prompt phases. The following acronyms are presents in the figures below; RT – Regular Time, IT – Irregular Time, RE – Regular Event, IE – Irregular Event.

Child 1.

Throughout the positive reinforcement phase, Child 1 performed accurately on the regular time-based tasks, with his accuracy increasing across weeks (Figure 6, black diamonds). His accuracy on the irregular time-based tasks also steadily increased in the positive reinforcement phase, however, accuracy

decreased again in the last week (Figure 6, white squares). Child 1's accuracy on the event-based tasks were considerably lower than his performance on the time-based tasks. Child 1 did not respond correctly to any regular or irregular event-based tasks in Week 1. For the regular event-based tasks his accuracy improved responding to 50% (0.5) of tasks in Week 2 (Figure 6, grey triangles). For the irregular event-based tasks accuracy remained low for the duration of the positive reinforcement phase (Figure 6, striped circle). Child 1 participated in a prompt phase and there was a slight decrease in his accuracy of responses for regular time and regular event tasks. For the irregular time-based tasks Child 1 accurately responded to 50% (0.5), there was no considerable change in accuracy in the prompt phase for these tasks. Child 1 accurately responded to more of the irregular event-based tasks in the prompt phase than the positive reinforcement phase.

Child 2.

Child 2 performed accurately on the regular time-based tasks, with his accuracy at 100% for 2 virtual weeks during the positive reinforcement phase (Figure 7, black diamonds). Accuracy to the irregular time-based tasks increased steadily during the positive reinforcement phase, reaching 83% (0.83) in virtual Week 3 (Figure 7, white squares). Child 2 did not respond correctly to any regular or irregular event-based tasks in Week 1. Accuracy in responding to these tasks improved in the positive reinforcement phase, for the regular and irregular event-based tasks correct responding reached 83% in Week 3 (Figure 7, grey triangles, striped circles) respectively. In the maintenance phase, there was an increase in accuracy in for the irregular time, regular event, and irregular event PM tasks from the positive reinforcement phase. There was no increase in accuracy for the regular time-based tasks, with responding at 100% (1.0) for Child 2.

Child 3.

During the positive reinforcement phase Child 3's accuracy increased steadily across a number of PM tasks. Accuracy for the regular time-based tasks increased steadily during the positive reinforcement phase, reaching 100% (1.0) or correct responses in Week 3 (Figure 8, black diamonds). Variability in correct responding was observed for the irregular time-based tasks, increasing in Weeks 1 and 2 and then decreasing again in Week 3 (Figure 8, white squares). For the regular event-based tasks Child 3's accuracy steadily increased throughout the positive reinforcement phase reaching a maximum of 75% (0.75) of correct responses. Child 3 responded most accurately to the irregular event-based tasks reaching 100% (1.0) in Weeks 2 and 3 (Figure 8, striped circles).

Child 4.

Child 4's regular event, irregular event, and regular time-based task performance was accurate in the positive reinforcement phase. There was a steady positive increase in the proportion of correct responses for the regular event tasks (Figure 9, grey triangles). For the irregular event-based tasks there was also an increase in his accuracy, reaching 100% (1.0) in Week 2 (Figure 9, striped circles). His accuracy for the regular time-based tasks steadily increased during the positive reinforcement phase (Figure 9, black diamonds). For the irregular time-based tasks, Child 4's responses remained stable for the duration of the positive reinforcement phase responding on average to 30% (0.3) of these tasks (Figure 9, white squares). In the maintenance phase, there was a slight lowering of the proportion of correct responses, these scores were still higher than baseline.

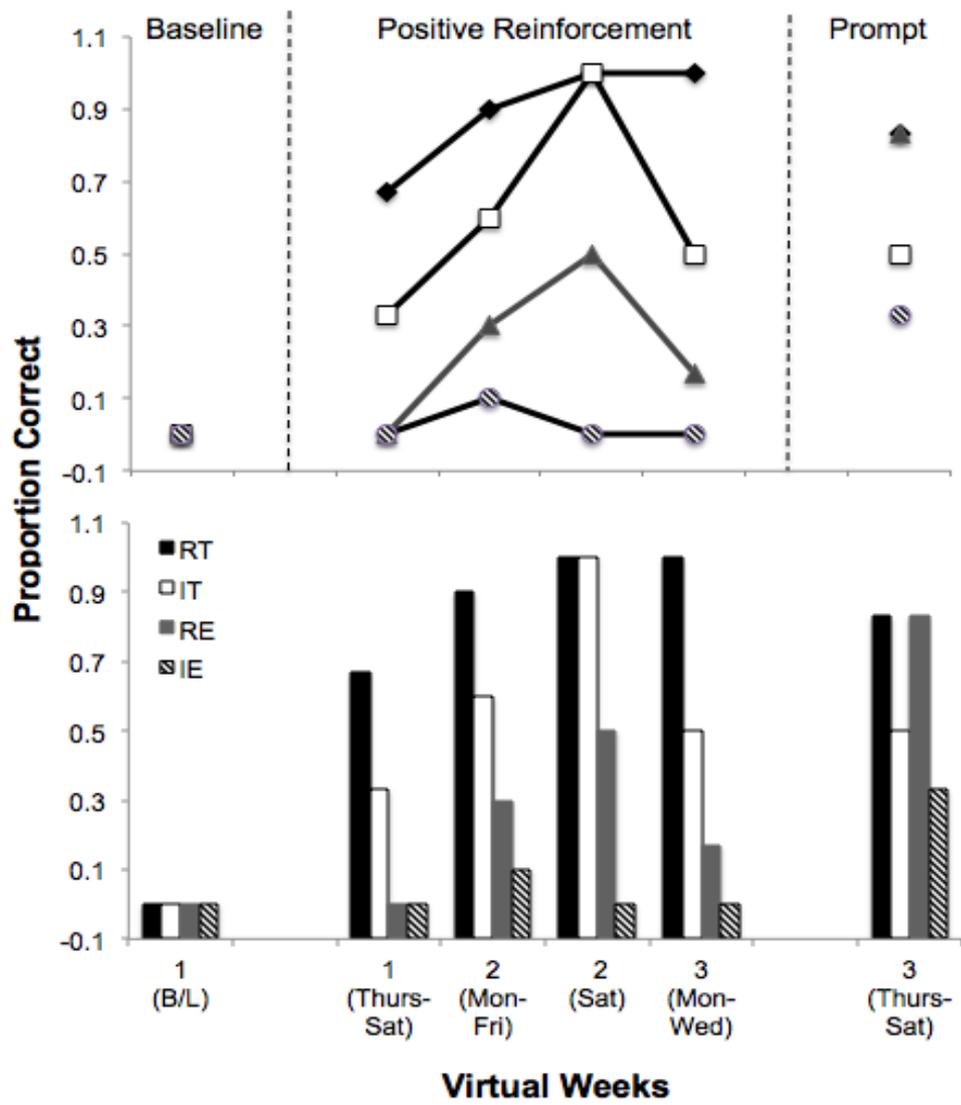


Figure 6. The proportion of correct responses for Child 1 in each session during baseline, positive reinforcement, and prompt phases.

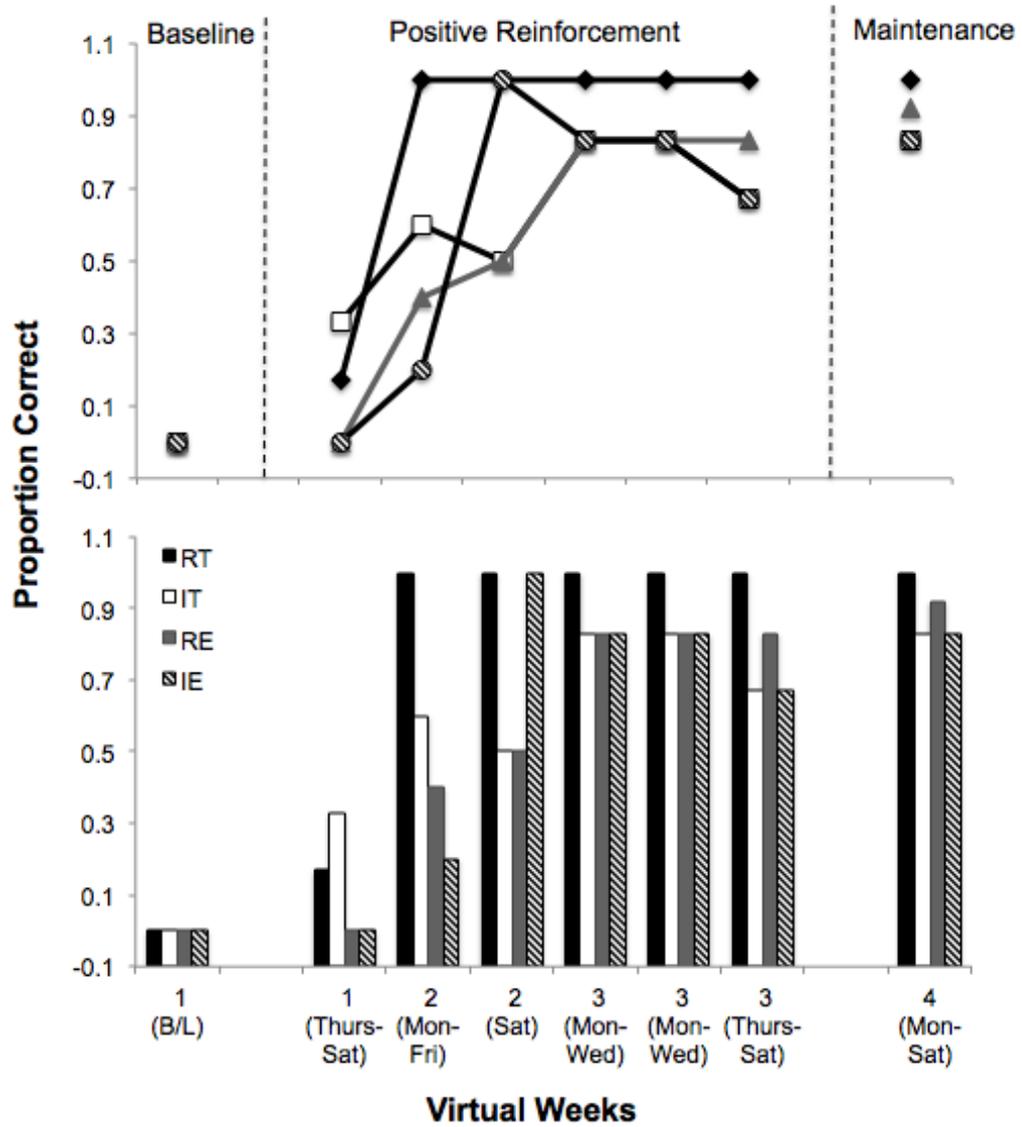


Figure 7. The proportion of correct responses for Child 2 in each session during baseline, positive reinforcement, and maintenance phases.

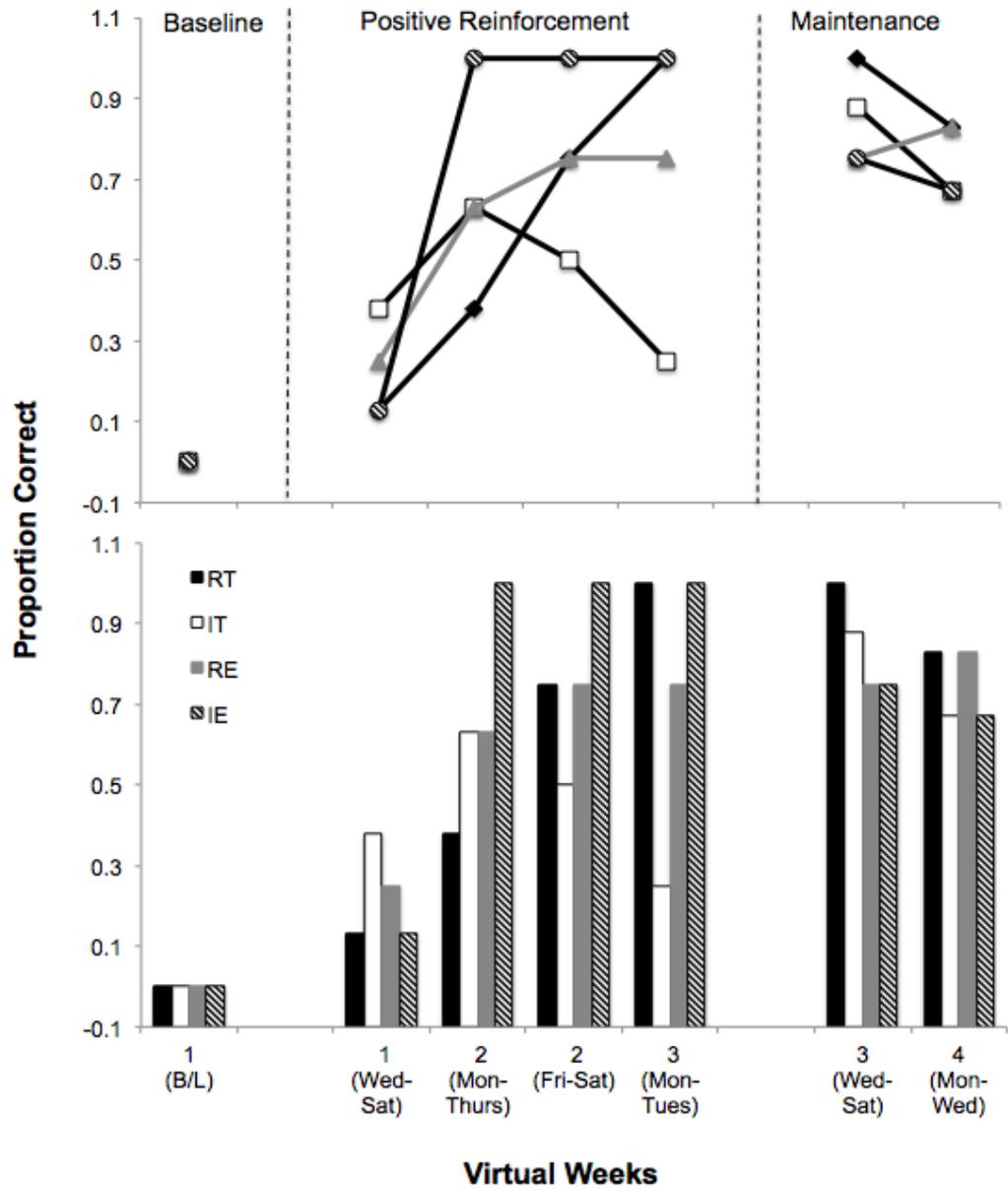


Figure 8. The proportion of correct responses for Child 3 in each session during baseline, positive reinforcement, and maintenance phases.

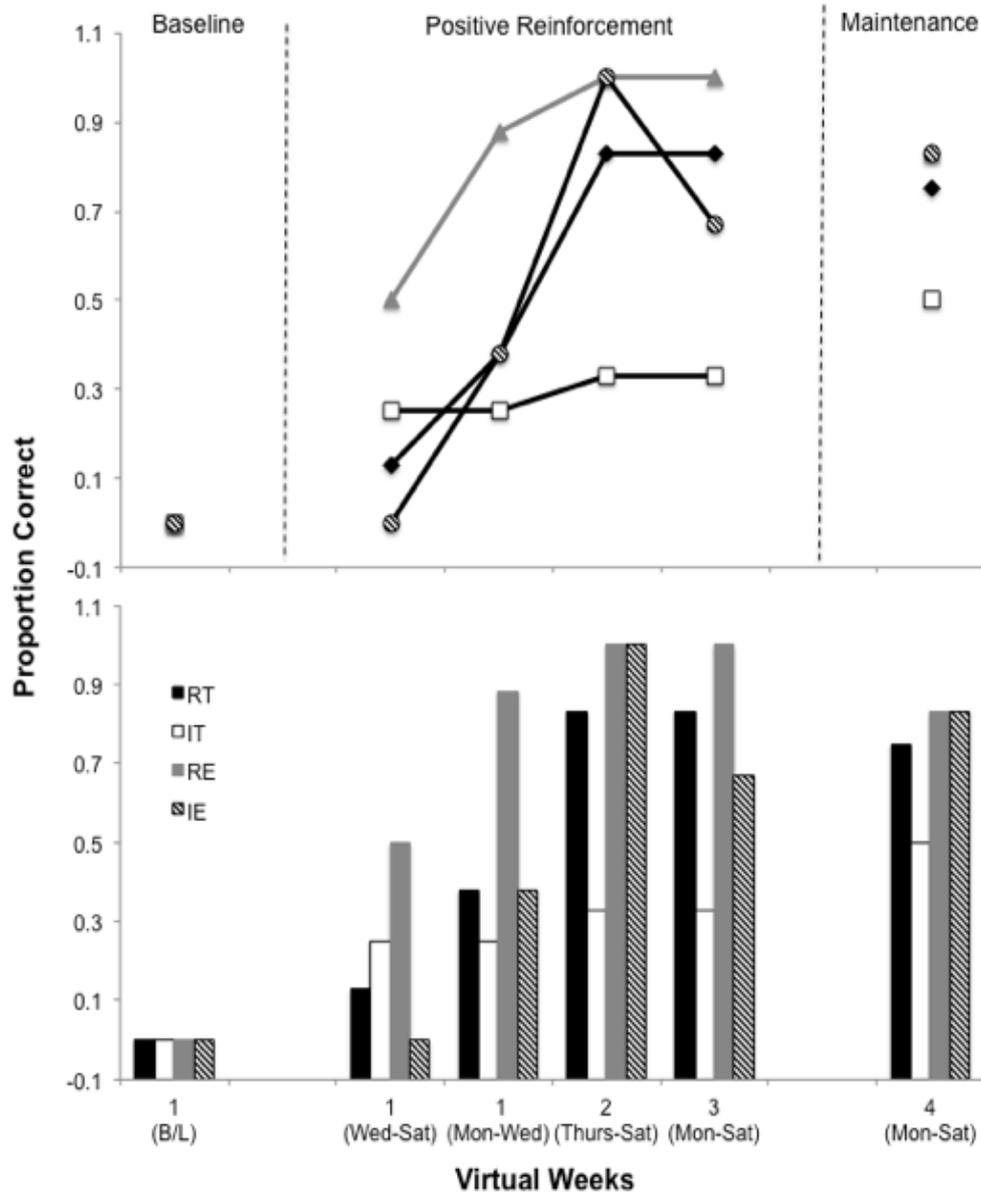


Figure 9. The proportion of correct responses for Child 4 in each session during baseline, positive reinforcement and maintenance phases.

Task Checking Data and Anecdotal Observations

A further aspect of this experiment was observing the various behaviours of the participants during the baseline, positive reinforcement, and maintenance (or prompt) phases. Observations were made during each session to determine if the participants were rehearsing the 'to-be-remembered tasks' and whether or not they exhibited task-checking behaviours. Figure 10 presents the data of the task checking behaviours of all participants during the baseline, positive

reinforcement, and maintenance (or prompt) phases of virtual week. The data show how often the 'perform task list' was opened but no task was selected. Figure 10 suggests that the participants may have opened the list to check on the PM tasks needing to be completed. During the baseline phase, all participants were observed to read the tasks aloud and count the token as it moved along the virtual board game. Only Child 1 exhibited task-checking behaviours in this phase. He checked the task list four times on Day 1 and on his last baseline day checked the list three times.

Throughout the positive reinforcement phase, each child demonstrated a variety of behaviours whilst participating in virtual week. Individuals with ASD tend to rely on the verbal rehearsal of information as a means of supporting task performance (Williams et al. 2012). Each child checked the task list more in the positive reinforcement phase than in the baseline phase. Child 1 demonstrated some checking behaviours averaging two task list checks per virtual day (Figure 10, Child 1). Child 2 checked the list at least seven times on some virtual days when he needed to complete a task for that day (Figure 10, Child 2). On average Child 2 opened the task list twice per virtual week day. Child 3 and 4 exhibited increases in their checking behaviours towards the end of the positive reinforcement phase. Child 3 checked the list on three occasions on Day 8 and increasing to five checks on Day 14 (Figure 10, Child 3). During this phase, Child 4 averaged one task check per virtual day and increasing to five task checks on Day 11. At the end of the positive reinforcement phase, Child 4 checked the list on four occasions per virtual day (Figure 10, Child 4).

In the maintenance and prompt phase Children 1 and 2 showed no change in their task checking behaviours remaining at the same level as the positive reinforcement phase, checking the list at least once per virtual day. Children 3 and

4 decreased their task-checking behaviours. Child 2 frequently checked the tasks to be completed at the same rate he did in the positive reinforcement phase.

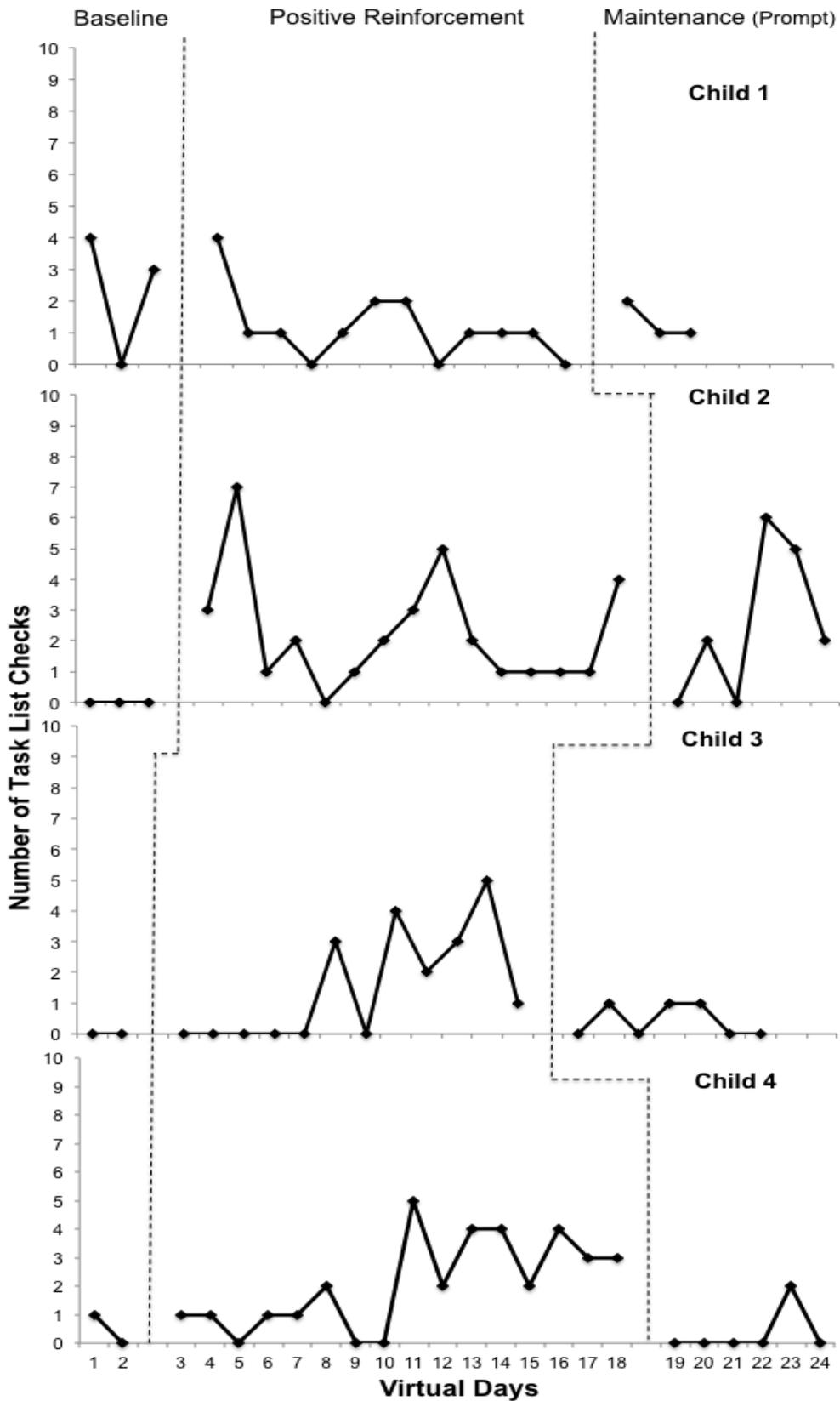


Figure 10. Number of times the task list was opened with no task selected plotted for each virtual day for all children per virtual day.

Discussion

There were two aims for my study, firstly I aimed to assess the prospective memory abilities of each child when completing virtual week. My second aim was to investigate if reinforcing the prospective remembering of children with Autism Spectrum Disorder increased the probability of those behaviours occurring again. I replicated previous research that introduced reinforcement to improve the memory behaviours of children (Balstruchat et al., 2011a and 2011b). All four participants improved their prospective memory performance in the positive reinforcement phase. These effects were maintained after reinforcement was discontinued for three out of four children. This is the first study of which I was aware that used a positive behavioural intervention to improve prospective memory of children with ASD. I discuss the findings below.

Positive Reinforcement and Memory

Positive reinforcement was delivered when the participant correctly remembered a PM task, increasing the probability of remembering in the future. I found that positive reinforcement was effective when implemented for all four participants. The participants' correct PM responses increased immediately when reinforcement was introduced and their missed responses decreased, thus, reinforcement improved the target behaviour. Baltruschat and colleagues (2011a; 2011b) found that as a result of a positive behavioural intervention, the working memory performance of children with ASD significantly improved. My data therefore support the premise that remembering may be amenable to change via basic behavioural procedures such as positive reinforcement.

Conflicting results have been found when using rewards and positive reinforcement with children and adults for remembering. Meacham and Singer (1977) examined prospective memory of university students using high and low

incentives. Regardless of whether the task was completed on a regular basis, they found that incentives improved prospective remembering in the participants. Similarly, Krishnan and Shapiro (1999) investigated the influence of a monetary reward on prospective memory performance. Overall, higher prospective memory performance was observed for the group that were promised a monetary reward. The results from these studies are supported by my research whereby each participant improved their prospective remembering in all PM tasks when positive reinforcement was introduced. In particular, Children 2 and 3 showed a gradual increase in their correct PM responses to the tasks when they received positive reinforcement (Figures 4 and 5). Similar improvements were also evident for Children 1 and 4, although their accuracy was more variable. Accurate remembering increased over baseline levels when the children were provided with positive reinforcement for remembering to perform a task.

In contrast, Guajardo and Best (2000) compared the performance of preschoolers on computerised prospective memory tasks using a mixed-group design. Their results indicated that neither an incentive nor external cues improved prospective memory performance of these children. Kliegal and colleagues (2010) also found no significant effects of motivational incentives on prospective memory performance. The researchers of both studies explained that the results obtained might have been due to the way motivation was manipulated. In both studies, each group was offered the same reward for providing a correct prospective memory response throughout each study. Neither of the above studies tested the potency of reinforcers for individual children prior to the beginning of the experiment, nor did they change the reinforcers and/or motivation offered during the experiment when no changes in prospective remembering were observed.

Skinner (1956) outlined the major constructs of reinforcement and argued that what functions as a reinforcer would be idiosyncratic and therefore reinforcers should be selected based upon the preference of a learner. This is because what is reinforcing for one individual may not be reinforcing for another. I provided individualised reinforcers for all participants for my study. The parents/guardians of each child chose the reinforcers that their child wanted to earn for the duration of the study. Reinforcers must be valued, preferred, and individualised and, therefore, when implementing a behavioural intervention with reinforcement, some form of reinforcer selection must be undertaken (Neitzel, 2010).

My decision to have the families of each child select the reinforcers improved my chances of selecting effective reinforcers for each participant enabled me to ensure that each participant would be motivated to earn what was on offer. Using the Reinforcer Assessment for Individuals with Disabilities (RAISD), Fisher and colleagues (1996) found that caregiver predictions of preferences for those with disabilities were slightly better than those generated for the standard set. In addition, Cote, Thompson, Hanley, and McKerchar (2007) replicated Fisher et al., (1996) and assessed the preferences of young children in an educational setting. They found that incorporating teacher nomination of reinforcers with a direct assessment may result in the identification of more effective reinforcers for young children in classroom settings (Cote et al., 2007). Although Fisher et al.'s (1996) and Cote et al.'s (2007) results were obtained in conjunction with systematic preference assessments, it is encouraging that caregivers in my study were able to choose effective reinforcers. I used an informal caregiver assessment, whereby the parents were asked what items their

child would work for. If the reinforcers were chosen by myself, then they may not have been as effective.

Another advantage of the caregiver method of assessing preferences is that it is simple and easy to conduct in comparison to other direct assessments such as paired stimulus or multiple stimulus preference assessments. Due to the changing nature of the children's preferences, the reinforcers were subject to change between sessions. Direct assessments are more labour intensive and take up more time, it would have been impractical for the families and the children to conduct these assessments prior to each session of Virtual Week. I avoided the potential pitfall of requiring the parents to purchase a number of items that may not have been reinforcing at all to the children. Lastly, I was able to change the reinforcers frequently to prevent satiation. Satiation is a situation in which a particular reinforcer is no longer motivating to the individual, it can occur if the same reinforcer is used over an extended period of time or perhaps if too much reinforcement is delivered (Neitzel, 2010). This method enabled me to maximise the time I had with each child when completing the PM tasks in Virtual Week and to ensure that they would be motivated to earn their particular reinforcers.

Research Design and Methodological Considerations

Previous research in the area of prospective memory has largely used between-group or within-group designs (Aberle and Kliegel, 2010; Altgassen et al., 2009; Altgassen et al., 2010; Brandimonte et al., 2013; Henry et al., 2014; Kerns, 2000; Kerns and Price, 2001; Kliegel et al., 2010; Kliegel et al., 2004; Kliegel & Jager, 2007; Kvavilashvili et al., 2001; Mahy et al., 2011; Smith et al., 2010; Talbot and Kerns, 2014; Williams et al., 2013; Yi et al., 2014). By implementing a group design, the researchers could only consider the prospective memory deficits found for children with ASD at a group level rather than on an

individual basis. For example, the results in my study showed that each child had varying skills on different prospective memory tasks, some children performed more accurately on the time-based tasks and others more accurately on the event-based tasks. Further, there are also differences in remembering behaviours for the regular tasks and irregular tasks for each child.

In my study, I originally intended to use a multiple-baseline-across-participants design (Cooper, Heron, Heward, 2014). In this design, a steady state of responding is achieved under baseline conditions. After baseline, the independent variable is applied with one of the participants whilst baseline conditions remain in place for the other participants (Cooper et al., 2014). Unfortunately, due to environmental circumstances of some of the participants the design was altered to a single-subject ABC design.

Implementing a single-subject design enabled me to make decisions for each individual throughout the entire experiment. This design is advantageous for a number of reasons. Firstly, none of the children were assigned to a no-treatment control group therefore each child was given the opportunity to earn reinforcement, avoiding any potential behavioural issues arising. Second, in this design each participant is used as their own control, therefore, it is possible to demonstrate an effect with a smaller number of subjects, in comparison to the means of groups (Butler, Sargisson, & Elliffe, 2011). Lastly, the characteristics of each individual and their PM responses could be examined in detail providing more useful information than a group percentage of PM responses.

Two factors led to the decision not to apply a multiple-baseline design. Firstly, two participants lived in the same household, so it was not practically possible for me to provide positive reinforcement for one child in the household, and withhold reinforcement for the other. Second, introducing the children to the

game and setting the children up to receive reinforcement and not providing it would have been problematic due to the restrictions in time with the families and also due to the diagnoses of the children. Lastly, all children were unable to respond correctly to any prospective memory tasks in the baseline phase therefore it would have most likely been detrimental to continue exposing each child in this phase with no intervention being introduced. Therefore, I chose a single-subject design (ABC) in order to see individual changes in prospective remembering when reinforcement was delivered for each child.

Due to the varying PM responses of the some of the children, decisions were made in regards to when each child would move into the next phase. Positive reinforcement alone did not produce accurate responding for all participants. Child 1 had variable responses throughout the positive reinforcement phase and an in-game prompt was required to increase accurate PM responses. In a group design, individual decisions on accurate PM performance cannot be made. However, with a single-subject design, I was able to identify which child needed a prompt, and which children did not during the positive reinforcement phase. Child 1's responses increased after the prompt was introduced, this suggests that by mediating the behaviours of the child through the use of a prompt, their remembering behaviours improved accurate responding to a higher level. This is similar to an intervention called scaffolding, which emphasises the role of adult intervention and assistance in cognitive development (Wood & Middleton, 1976). The support provided is temporary and the child is gradually given less support as they become more proficient in a particular skill (Wood & Middleton, 1976). The remembering behaviours of Child 1 may have required explicit teaching in order for him to improve his accuracy, without it, Child 1 would not have known how to respond to the tasks. Given that each participant's level of functioning was

different, each child would be influenced by a prompt depending on the degree to which the mediating behaviour is in the participant's repertoire.

Baseline Phase.

The results from the baseline phase indicate that the children had difficulty remembering prospective memory tasks, with all participants failing to respond correctly to any PM tasks. The baseline findings are in line with previous research whereby children with ASD have been found to have a deficit in prospective remembering (Altgassen et al., 2009; Brandimonte et al., 2013; Henry et al., 2014; Yi et al., 2014). PM performance in my study was less accurate than that of children with ASD found by Henry et al. (2014). The participants performed quite differently from those in Henry et al's study, with no correct PM responses being made in the first two or three virtual days. In comparison, Henry et al. (2014) showed that for three virtual days the participants responded to 65% (0.65) of the regular event and 28% (0.28) for regular time tasks in virtual week. In my study, remembering in the baseline phase was lower compared to Henry et al (2014).

Positive Reinforcement Phase.

Contrary to the findings mentioned previously (Guajardo et al., 2000; Kliegal et al., 2010), I found accurate responding for prospective memory performance for children with ASD when positive reinforcement was introduced. My results indicated that some participants were able to remember almost all of the prospective memory tasks presented on a virtual day, regardless of whether the tasks presented were event- or time-based, or regular or irregular tasks. Due to my study being the first of its kind implementing a behavioural intervention with an aim to improve prospective memory, there are no other results from a positive reinforcement phase to compare it to.

However, Baltruschat and colleagues (2011a; 2011b) demonstrated that a positive behavioural intervention can improve the working memory of children with ASD on a counting-span task. During their positive reinforcement phase, correct responding increased immediately for the first participant, reaching 100% and remaining stable for 12 sessions. For the second participant, accuracy reached 74% for the duration of this phase. Lastly, Participant 3 performed similarly to the first participant, with an immediate increase in accuracy when positive reinforcement was introduced reaching 92%. In comparison, my participants also demonstrated an immediate increase in the accuracy of their responses when positive reinforcement was introduced. Child 2 correctly responded to all 8 tasks on Days 14 and 17 during the positive reinforcement phase. Child 3 demonstrated that he could remember at least 6/8 tasks for six virtual days during his reinforcement phase. Lastly Child 4 averaged 6/8 correct PM responses and reached the maximum of correct responding on Day 10 (Figure 5, white diamonds).

Furthermore, I analysed the types of tasks that the children responded to (regular and irregular event and regular and irregular time-based tasks). Child 1 and Child 2 responded to all regular time-based tasks during Weeks 2 and 3 of virtual week in the positive reinforcement phase. In contrast, Child 3 performed accurately on the regular event-based tasks, remembering all tasks presented in Weeks 2 and 3. Lastly, Child 4 responded most accurately to the regular and irregular event-based tasks during the positive reinforcement phase. The findings suggest that there is no pattern of responding between the participants, with responding accurately to either or both the time- and event-based, regular or irregular tasks. The results are encouraging because positive reinforcement is one

of most fundamental of behavioural procedures, simple to implement and may be effective for any type of difficulty.

Maintenance and Prompt Phase.

Improved PM performance was observed for three of the four children throughout the positive reinforcement phase and therefore the maintenance phase was introduced. This phase was identical to baseline and I gave the children no reinforcers for a correct response and no feedback as to whether they performed the tasks correctly. The aim was to test whether the behaviour of remembering would continue in the absence of explicit reinforcement and, thus, whether or not the behaviour of remembering changed as a result of reinforcement. Although a limited number of virtual days was completed, Child 1's performance improved immediately when the in-game prompt was introduced. It would have been beneficial to examine Child 1's performance further with more virtual days. If his correct remembering improved, the in-game prompt could have been faded, giving the participant the opportunity to remember by himself. Alternatively, if his accuracy in responding decreased, another prompt or intervention may have been appropriate. Unfortunately, Child 1 chose to complete his participation in the experiment after 3 days in the prompt phase.

For the remaining three children, accuracy in the maintenance phase was considered stable if they remembered 6/8 tasks for a minimum of five virtual days (Figures 3 and 4). The results indicate that Children 2 and 3's accuracy was at the same level as the positive reinforcement phase. Child 4 did not meet criteria for stable responding in this phase, however, he remembered a minimum of 5/8 tasks for the duration of the phase. His responding to the PM tasks was above the baseline phase. Thus, 3 out of 4 children were able to accurately respond to the PM tasks without receiving any form of positive reinforcement.

Accuracy in PM responding in the maintenance phase was more accurate than for children in previous studies who had not received positive reinforcement. For example, Henry et al. (2014) found that the accuracy of responses were 71% for irregular event based tasks and the lowest were 25% of responding to the irregular time-based tasks in their group design. In my study, Children 1 and 4 reached 80% and Children 2 and 3 reached 100% in responding to regular time-based tasks in the maintenance phase. For event-based PM responses, Children 1, 3, and 4 achieved 80% and Child 2, 90%. These results suggest that the delivery of positive reinforcement for a period gives participants the opportunity to improve their accuracy on PM tasks, it may also provide them with an opportunity to develop strategies to remember. Therefore, if the children in Henry et al.'s (2014) study had been given the opportunity to earn reinforcement, perhaps improvements in PM accuracy would be observed. It is important to note, however, that the above research focused on finding a deficit in prospective memory, and improving prospective memory was not an aim of the authors.

In my study, one maintenance and/or prompt session was undertaken for each child due to the time restrictions of the families. Although the results found are positive, limited conclusions can be made about the participants' performance and it would have been beneficial to administer more virtual days. By extending the length of the maintenance phase, more detailed response patterns to the PM tasks could be analysed.

Tasks (Event versus Time-Based, Regular versus Irregular)

The results mentioned above demonstrate the individual differences in task performance in Virtual Week. Previous research has found mixed results for prospective memory, in particular the finding that there is no deficit in event-based PM and time-based PM remains intact. Firstly, I found that Child 1 had a

deficit in event-based irregular tasks responding to only 30% of those tasks in the maintenance phase. Even after receiving positive reinforcement, his responses did not increase to a level above chance. These results support those of Yi et al., (2014) and Brandimonte and colleagues (2013) who found a deficit in event-based PM responding for children with ASD in comparison to neurotypical controls.

On the contrary, Williams and colleagues (2013) found that performance on event-based tasks was unimpaired for children with ASD. In this phase, children 2, 3, 4 demonstrated accurate PM performance on the event-based tasks. All three children were able to respond to at least 80% of the regular and irregular event-based tasks. Altgassen and colleagues (2010) support these findings whereby there were no significant group differences found between children with ASD and controls in event-based PM performance. Similar results have also been found in adults with ASD, with findings indicating diminished time-based PM performance but undiminished performance on event-based PM tasks (Henry et al., 2014; Williams et al., 2014).

The majority of research conducted on prospective memory for children with ASD has found a deficit in time-based prospective memory (Mioni et al., 2013; Henry et al., 2014; Williams et al., 2013; Williams et al., 2014). During the maintenance phase of my study, all participants were able to respond above 80% for the regular time-based tasks and on average 70% for the irregular time-based tasks. They received no positive reinforcement for these responses. In particular, Children 2 and 3 responded accurately to 100% of the regular time-based tasks. It is encouraging to discover that time-based prospective remembering can be improved with children with ASD through positive reinforcement. When performance is analysed at an individual level, strengths and weaknesses of each child become apparent. I provide support that PM deficits for children with ASD

are idiosyncratic and there is no definitive answer as to whether they demonstrate poorer performance on event-based tasks versus time-based tasks.

The results discussed above demonstrate the importance of study design when investigating prospective memory performance of children with ASD. Some alterations to this design for future research could include designing harder tasks for the children to complete. Throughout the game, all tasks were either regular or irregular and most of the children memorised and knew the regular tasks that were to appear each day because they did not change. In future, it would be beneficial to examine performance with some children for only the irregular tasks because these tasks are more difficult to complete.

Each child is different and therefore performance on these tasks needs to be considered at an individual level rather than a group level. All of the tasks chosen in my study were applicable to the children and that particular age group. It was advantageous that I knew three of the children and worked in a school environment, allowing me to tailor the tasks towards some of the activities that they liked to participate in or activities that they would complete throughout their school day. When replicating this study, it is important to take into consideration the task design, ensuring that the tasks match the culture, language, and age group of the participants. General knowledge of the sample is beneficial to this form of research. It is important to make the tasks as realistic as possible, that way the participants are involved and feel like they are completing tasks similar to ones that they would complete in real life. By making the tasks realistic, it is also more likely to improve the chance that the behaviour will generalise to real life.

A change that I would implement if I were to undertake this experiment again would be to differentially reinforce the children's responses on the regular versus irregular tasks. During the experiment, it became apparent that the children

memorised the regular tasks that were to appear each day and, in retrospect, these were much easier to remember than the irregular tasks. It would have been beneficial to provide a reinforcer of lower value or fade out reinforcement altogether for regular asks. For the irregular tasks, reinforcement could be altered whereby those tasks that have more significant consequences, such as missing a doctor's appointment, are given a higher value reinforcer. For those tasks that are considered 'minor' in everyday life, for example, remembering to pack your homework book, they could be allocated a reinforcer of lower value.

Task Checking Data and Anecdotal Observations

Anecdotal observations were made during each session with the purpose of determining if the participants were rehearsing the 'tasks to be remembered and whether they exhibited task-checking behaviours. I observed that even though the children were not prompted to engage in rehearsal behaviours, they frequently appeared to use their own strategies, such as self-talk. The children would recite the tasks throughout the virtual day in order to remember when the tasks needed to be completed. These behaviours appeared to increase during positive reinforcement for correct responses. The data show when the 'perform task list' was opened and no task was selected (Figure 10). The ability to check the task list made it possible for the children to use the list as a strategy to improve performance.

During the positive reinforcement phase, I observed Child 1 engage in overt verbal rehearsal, in particular, he referenced how many tasks he had to complete and commented on when he 'missed' a time-based task. For example, Child 1 'missed' the task that required him to attend math's tutoring at 3pm. When he realised he had missed it, he was quite verbal in deciding whether to complete the task (late) or just miss it altogether. In addition, Children 2, 3, and 4

also overtly commented on their performance in virtual week. For example, if Child 2 could not remember an event he would say, “I better check the perform task list and see if there is anything I need to do”. This anecdotal observation is supported by data whereby he checked the task list at least seven times on some virtual days to see if he needed to complete a task for that day. Children 3 and 4 exhibited increases in their checking behaviours towards the end of the positive reinforcement phase (Figure 10), checking the list five times each on Days 14 and 11.

Children 3 and 4 were also more focused on the time-based tasks and this was demonstrated by their increase in referencing the time clock in the middle of the virtual week board. Both children made comments such as ‘It is 2.50, I need to meet my friends at Donut King at 3pm’ or ‘it is 8am and breakfast time now, this reminds me of something’. Although my participants were not compared to a typically developing control group, these observations differ to Altgassen and colleagues (2009) who found that children with ASD checked the time less often and showed time-monitoring behaviours that were different from controls. The task-checking data, in combination with the PM results from the positive reinforcement phase, suggest that although most of the participants were checking the task list, this did not affect their performance on the prospective memory tasks.

Maintenance and Prompt Phase.

In the maintenance and prompt phase, Children 1 and 2 showed no change in their task-checking behaviours remaining at the same level as the positive reinforcement phase (Figure 10, Children 1 and 2). Alternatively, Children 3 and 4 decreased their task-checking behaviours (Figure 10, Children 3 and 4).

Performance on the tasks for Children 3 and 4 did not decrease, but was

maintained throughout the phase, suggesting that active task checking was not required for accurate performance on PM tasks.

Generalisation of Prospective Memory

Prospective memory is an important part of daily cognition and it represents a crucial element in planning and controlling everyday activities. In review of the current research it would be beneficial to examine prospective memory further in everyday situations. Successful performance in real-life PM tasks is an important determinant of whether an individual is able to lead an independent life (Rendell & Henry, 2009). For children with ASD to become independent they must develop the ability to carry out behavioural intentions in the presence of other ongoing activities that occur in daily life. My study has shown that these skills can be taught in a controlled setting and the next step would be to teach these skills in everyday situations.

One approach to addressing the need of generalisation in a naturalistic setting is to implement the use of say-do correspondence training. Traditionally, say-do correspondence training involves the modification of nonverbal behaviour via changes in verbal behaviour (Rosenberg, Congdon, Schwartz, & Kamps, 2015). In correspondence training, the individual receives access to a reinforcer for demonstrating correspondence between “saying:” stating what they are going to do at a particular point in the future, and “doing:” actually doing what they said they were going to do (Rosenberg et al., 2015). This approach has been successful in training children with ASD and intellectual disabilities to increase generalisation of social interaction skills and appropriate classroom behaviour (Rosenberg et al., 2015; Whitman, Scibak, Butler, Richter, & Johnston, 1982).

To train children to remember prospective tasks using say-do correspondence, the child would be expected to state the task requirement, for

example, “I need to pick up my school report at recess time”. The child would be shown an array of reinforcers and asked which one they like to earn if they said and did what they intended to do. The researcher undertaking the study would keep the reinforcer during this time. If the child completed the specified task and the correct point in time (picked up their school report at recess) then they would receive their pre-selected reinforcer. If not, they could be given the opportunity to earn a reinforcer with the same task again at another point in time or with another PM task. This approach would be ideal for the school or home environment whereby the child will encounter multiple opportunities to ‘remember’ throughout the day. It is important to note that this approach is not used to teach a new skill, but rather to generalise the children’s ‘remembering’ behaviours that have been practiced extensively.

Limitations

A number of limitations arose from the completion of this study. Firstly, it is unclear whether a practice effect occurred due to repeated presentations of Virtual Week. Although the irregular PM tasks each virtual day were altered, the regular health tasks stayed the same throughout the duration of the study. With each virtual day, the participants knew the upcoming health tasks and how many there were to remember. Furthermore, the same numbers of tasks were presented each virtual day resulting in the children remembering that they had eight tasks to complete. The knowledge that there were eight tasks may have served as an inadvertent prompt as to the number of tasks coming up and how many they had left at the end of each virtual day. In retrospect, it would have been better to vary the number of tasks encountered each virtual day to replicate everyday situations. By changing the number of tasks delivered each virtual day, this would be more realistic, in everyday life the daily tasks that need to be completed will vary.

Secondly, limited maintenance sessions were conducted for some of the participants. Because the study was carried out in the participants' homes and was limited to after school hours and school holidays, sessions were arranged around other school activities and the schedules of each family. It might have been possible to obtain more data had the research been conducted in the school environment.

Another potential limitation of the current study is that the generalisation of the prospective memory tasks was not examined in real-life situations. The participants' performance was not evaluated in everyday situations whereby the participants had to complete naturalistic prospective memory tasks (not within a computer board game) at school or at home. Although the lack of data on generalisation is a limitation, this was not an aim of the current study. My goal was to examine whether a behavioural intervention could produce an improvement in the prospective memory behaviours of children with ASD.

Future Research and Conclusion

My study was the first to demonstrate a behavioural intervention on prospective memory for children with ASD. The present findings create possibilities for further research for children with ASD and the role of positive reinforcement. I have shown that positive reinforcement can contribute to changing the prospective remembering of children with ASD. It is imperative that further study be undertaken on memory in this manner, because behavioural interventions allow researchers to change the behaviours and improve memory of children.

Research on prospective memory could be extended by reinforcing the behaviour of remembering to real-life situations, giving children the opportunity to complete tasks at school and at home. By facilitating the prospective

remembering opportunities, it would enable the children to generalise their skills and therefore contribute to their overall functioning in everyday life. Furthermore, it would be beneficial to study the differential reinforcement of completing these tasks in the real world. In real life there are consequences and reward payoffs for completing tasks. By differentially reinforcing important tasks, this may enable children and adults with a deficit in prospective memory to implement strategies to help them carry out these tasks each day.

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APPENDIX A

VOLUNTEERS NEEDED

Does your child forget to bring their reading folder to school? Or do they need to be constantly reminded about what to pack for the school day?

Volunteers are needed to participate in research on the effect of reward on prospective memory in school-aged children with autism spectrum disorder. The research will use a board game called "Virtual Week" demonstrating daily activities that children need complete throughout their school day.

Participants must be:

- At least 6 years of age
- Have a diagnosis of Autism Spectrum Disorder
- Attend a mainstream primary school

Participants will receive:

- If the children perform the prospective memory tasks correctly they will receive a reward each time that they do so.

Participants will not be reimbursed for their time and participation is entirely voluntary and confidential.

Contact Information:

To have your child participate in the research or for more information please email Monique Peisley at mpeisley@gmail.com or call on 0432630569.

APPENDIX B



INFORMATION SHEET

Project Title: Prospective Memory in School aged Children with Autism Spectrum Disorder

Researcher: Monique Peisley

Supervisors: Mary Foster & Rebecca Sargisson, University of Waikato, New Zealand.

Introduction

I would like to invite your child to participate in this research project, which is concerned with the role of reward on prospective memory in children with autism spectrum disorder. In everyday life children are required to carry out future intentions, for example to hand over a permission note to the class teacher in the morning. The ability of remembering to initiate and execute this intended action at some time in the future is called prospective memory. Therefore I am interested in ascertaining whether an edible reward will improve children's performance on daily prospective memory tasks.

Why am I doing the project?

The research project is a component of my final year of a Masters degree in Applied Psychology at the University of Waikato. It is hoped that the project will provide useful information for teachers and students about the role of reward in changing prospective memory behaviours in children.

What will you have to do if you agree to take part?

1. Return the consent forms from both you and your child to me
2. We will arrange a time to meet, which is convenient for you in your own home (if that is appropriate).
3. There will be one session, during which your child will play a computerised board game. During this game they will complete a number of tasks designed to assess prospective memory, if they perform each task correctly they will receive an edible reinforcer (see attached list of proposed reinforcers).
4. When I have completed my research I will produce a summary of my findings, which will be made available to you upon request.

How much of my child's time will participation involve?

The virtual game will last approximately 1 hr per session (with short breaks given in between).

Will my child's participation in the project remain confidential?

If you agree for your child to take part in this research, their name will not be recorded on the computer program and the results will not be disclosed with any other parties. Your child's responses will only be used for the purpose of this project only. It is assured that their participation in the project will remain anonymous.

What are the advantages of taking part in the research?

You and your child may find the research project interesting and your child will enjoy playing the virtual week board game. Once completed the research will hope to provide useful information on children's memory in daily life.

Are there any disadvantages in taking part in this research?

No, there not any disadvantages for the children when taking part in the study.

Will there be any compensation?

Neither you nor your child will receive any type of payment participating in this study.

Does my child have to take part in the experiment?

No, your child's participation in the project is entirely voluntary and your child is not obliged to take part. If you do not wish for your child to take part, you do not have to give a reason and you will not be



contacted again. Similarly if you do agree for your child to participate you are free to withdraw them at any time (and they can withdraw themselves at any time) during the project.

What happens now?

If you are interested in your child taking part in this research project you are asked to fill out the parental consent form. Once I have received the consent form, we can arrange to meet at an appropriate time that is to your families convenience. I can then visit and conduct the experiment in your own home for a short period of time. If you decide that your child would rather not participate in this study, then you do not need to return the parental consent form to me. Simply ignore this information sheet and no further contact will be made.

Whom to contact with questions about the research project?

Prior, during or after your child's participation you can contact me at 0432630569 or send an email mpeisley@gmail.com for any questions regarding the research.

APPENDIX C


CONSENT FORM - Parents

Research Project: _____

| Please complete the following checklist. Tick (✓) the appropriate box for each point. | YES | NO |
|--|-----|----|
| 1. I have read the Participant Information Sheet (or it has been read to me) and I understand it. | | |
| 2. I have been given sufficient time to consider whether or not my child will participate in this study. | | |
| 3. I am satisfied with the answers I have been given regarding the study and I have a copy of this consent form and the information sheet. | | |
| 4. I understand that taking part in this study is voluntary (my choice/their choice) and that my child may withdraw from the study at any time without penalty. | | |
| 5. My child has the right to decline to participate in any part of the research activity | | |
| 6. I know who to contact if I have any questions about the study in general. | | |
| 7. I understand that my child will receive an edible reinforcer for correct prospective memory performance. | | |
| 7. I understand that my child's participation in this study is confidential and that no material, which could identify them personally, will be used in any reports on this study. | | |
| 8. I wish to receive a copy of the findings | | |

Declaration by participant:

I/we agree to participate in this research project and I/we understand that I/we may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Psychology Research and Ethics Committee (Associate Professor John Perrone, Tel: 07 838 4466 ext 8292, email: jpnz@waikato.ac.nz)

Participant's name (Please print): _____

Signature: _____ Date: _____

Declaration by member of research team:

I have given a verbal explanation of the research project to the participant, and have answered the participant's questions about it. I believe that the participant understands the study and has given informed consent to participate.

Researcher's name (Please print): _____

Signature: _____ Date: _____

APPENDIX D

Week 1: Event-Based Irregular Prospective Memory Tasks

| | Trial Day | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|----------|---|---|--|--|--|---|--|
| ID | 1 | 5 | 9 | 13 | 17 | 21 | 25 |
| Summary | Buy some pencils for school when shopping | Collect your trophy for running while you are at PE class | Ask Alex about your missing school book when you meet | Change your home reader book in your spare time | Pack your red folder into your school bag during math's | Put your rubbish in the bin when you go to play games at the carnival | Pick up some new crayons while you are out with your mother |
| Informed | Start Card | Start Card | Start Card | Start Card | Start Card | Start Card | Start Card |
| | | | | | | | |
| ID | 2 | 6 | 10 | 14 | 18 | 22 | 26 |
| Summary | Hand school note to parents when home before dinner | Buy a notepad for your friend when you next go shopping | Tidy up your room for your friend when you return home after walking the dog | Go to the swimming pool with your friends when your mum comes home | Give your parents your school report to sign when you get home | Meet your friends for a play when your dad comes home from work | Take the washing out from the washing machine when mum starts to clean the house |
| Informed | When teacher is asking about next excursion | At recess when you see your friend | Talking to mum about having your friend over for dinner | When you are back from church | Teacher is handing out school reports | At the athletics carnival wanting to go in a race. | Your friends suggests that you come over for a play date |

APPENDIX E

Week 1: Time-Based Irregular Prospective Memory Tasks

| | Trial Day | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|-------------|-------------------------------|---|-------------------------------|--|---|---|--|
| ID | 3 | 7 | 11 | 15 | 19 | 23 | 27 |
| Summary | Help set up the school hall | Need to phone your dad | Go to the dentist | Go to see Mrs Wagstaff | Meet your friends for ice-cream at the cafe | Go with your friend to the canteen to buy a treat | You look after your brother who is very grumpy |
| Target Time | 10:30am | 7:30pm | 2pm | 12pm | 3pm | 12pm | 12pm |
| Informed | Start Card | Start Card | Start Card | Start Card | Start Card | Start Card | Start Card |
| | | | | | | | |
| ID | 4 | 8 | 12 | 16 | 20 | 24 | 28 |
| Summary | At 8pm phone your sick friend | Go to the doctor's at 5pm to receive an injection | Go to the cinema with friends | Pack your art things for tomorrows art class | Water the plants in the house | Take your dog to the vet for surgery | Watch some fireworks |
| Target Time | 8pm | 9pm | 5pm | 8pm | 7:30pm | 3pm | 8pm |
| Informed | At lunchtime | At lunch time | Music class | When mum arrives home | At lunchtime | Walking to athletics carnival | At lunchtime |

APPENDIX F

| | Trial Day | MONDAY | TUESDAY | WEDNESDAY | THURSDAY | FRIDAY | SATURDAY |
|---------|---|---|--|---|---|--|---|
| 7:50am | <p><i>Trial Day breakfast</i> You have toast for breakfast. Do you have:</p> <ul style="list-style-type: none"> * Crunchy peanut butter * Smooth peanut butter * Plain toast | <p><i>Breakfast</i> During breakfast, you sit at the table. For breakfast, do you have:</p> <ul style="list-style-type: none"> * Cereal * Pancakes * Boiled eggs | <p><i>Breakfast</i> You are making your own breakfast today. Do you have:</p> <ul style="list-style-type: none"> * Toast with nutella * Toast with honey * Toast with jam | <p><i>Breakfast</i> During breakfast, you watch your favourite TV show Do you have:</p> <ul style="list-style-type: none"> * Pancakes * Cereals * Bread and eggs | <p><i>Breakfast</i> You have your normal breakfast. During breakfast you prefer to:</p> <ul style="list-style-type: none"> * Start fighting with your brother/sister * Listen to radio * Talk to your mum about your holiday plans | <p><i>Breakfast</i> While having breakfast you listen to the radio. For breakfast, do you have:</p> <ul style="list-style-type: none"> * Toast * Scrambled eggs * Fruit | <p><i>Breakfast</i> Your mother prepares your breakfast Do you have:</p> <ul style="list-style-type: none"> * Omelette * Bacon and eggs * Porridge |
| 9:20am | <p><i>After breakfast</i> You get ready for school You:</p> <ul style="list-style-type: none"> * Do your hair * Tidy your room * Brush your teeth | <p><i>English lesson</i> This morning at school you sit next to your friend. You are both:</p> <ul style="list-style-type: none"> * Participating in the lesson * Drawing a picture while listening * Chatting a lot | <p><i>Talk to mum</i> You and your mum decide to have your friend over for dinner tonight. Do you:</p> <ul style="list-style-type: none"> * Tell your best friend at school * Sit and wait in the car for school * Decide what movie you will see during the week | <p><i>Mass</i> You are attending mass at school. Do you:</p> <ul style="list-style-type: none"> * Sit with your friends * Next to the teacher * Pick a positive mass buddy | <p><i>Art lesson</i> You and your friend are working on finishing your art before the end of term. You get help from:</p> <ul style="list-style-type: none"> * Your friend Isaac * A teacher at the school * Your friend Cameron | <p><i>Athletics Carnival</i> You are walking to Holy Cross for the carnival. Your walking buddy is:</p> <ul style="list-style-type: none"> *Cameron * Isaac * Eva | <p><i>Walk the Dog</i> You take the dog to the park At the park do you:</p> <ul style="list-style-type: none"> * Race against your dog * Play fetch * Look for other dogs to play with |
| 10.50pm | <p><i>Art Show</i> You have an art show at school: During the show you:</p> <ul style="list-style-type: none"> * Look at your best friends art | <p><i>At recess, you see your friend.</i> During the recess, do you and your friend:</p> <ul style="list-style-type: none"> * Play handball * Buy lollies from | <p><i>Music Class</i> It is time to go to your music class with Mr Femia, during music. Do you play:</p> <ul style="list-style-type: none"> * Drums | <p><i>Back from church</i> Your teacher asks you to get your English book out Do you:</p> <ul style="list-style-type: none"> * Go and get your book | <p><i>Receive School Report</i> Your teacher is handing out school reports. In the meantime do you:</p> | <p><i>At the Carnival</i> You are at the carnival and would to go in a race. You run in the:</p> <ul style="list-style-type: none"> * 100m * Hurdles | <p><i>Play Date</i> Your friend suggests you come over for a play date next week. Do you:</p> <ul style="list-style-type: none"> * Immediately say |

| | | | | | | | |
|---------|--|--|--|--|--|---|---|
| | <ul style="list-style-type: none"> * Go around and look at other art pieces * Show parents your art work | <p>the canteen</p> <ul style="list-style-type: none"> * Play soccer | <ul style="list-style-type: none"> * Violin * Piano | <ul style="list-style-type: none"> * Get your book and start talking with your friend * Forget about getting your book | <ul style="list-style-type: none"> * Chat with your friend * Hope your teacher said good comment * Start thinking about the weekend | <ul style="list-style-type: none"> * 50m | <p>yes</p> <ul style="list-style-type: none"> * You do not want to * You would like to but you already have a play date booked in next week |
| 12:20pm | <p><i>Lunch</i></p> <p>Your friend is away today so you have lunch with other friends</p> <p>For lunch, do you have:</p> <ul style="list-style-type: none"> * Ham sandwich * Cheese sandwich * Tuna sandwich | <p><i>Lunch</i></p> <p>For lunch, today, do you have:</p> <ul style="list-style-type: none"> * An apple and sandwich * Yogurt and rice wheels * A pear, a biscuit and chips | <p><i>Lunch with Alex</i></p> <p>You decide to have a picnic lunch today.</p> <p>For the picnic do you have:</p> <ul style="list-style-type: none"> * Hamburgers in bread * Cheese and tomato sandwiches * Chicken and salad wrap | <p><i>Lunch</i></p> <p>Your mum prepared you pasta for lunch</p> <p>As a dessert, do you have:</p> <ul style="list-style-type: none"> * A yoghurt * An orange * A cookie | <p><i>Lunch</i></p> <p>At lunch you are chatting with your schoolmates. For lunch, do you have:</p> <ul style="list-style-type: none"> * Pie * Pizza * Sushi | <p><i>Lunch</i></p> <p>The school has organised a packed lunch for you:</p> <p>You choose</p> <ul style="list-style-type: none"> * Sausage sandwich * Hot Dog * Plain sandwich | <p><i>Lunch</i></p> <p>While you are having lunch, your friend Cameron and his mother drop in</p> <p>Do you:</p> <ul style="list-style-type: none"> * Ask them if they would like to have a drink * Ask them if they would like some lunch * They are in a hurry and can't stop. |
| 1:50pm | <p><i>Next school excursion</i></p> <p>Your teacher is asking where your class would like to go for their next excursion</p> <p>Your favourite excursion is:</p> <ul style="list-style-type: none"> * Science works * Aquarium | <p><i>You have sport class in the afternoon, you play with your best friend.</i></p> <p>You play:</p> <ul style="list-style-type: none"> * Hockey * Basketball * Table tennis | <p><i>Craft Afternoon</i></p> <p>You and your friend are making craft at school</p> <p>Do you make:</p> <ul style="list-style-type: none"> * A rocket * A house * Don't make anything you just play with the materials | <p><i>Spare time after lunch</i></p> <p>You do a puzzle now as you have finished all your school work. Do you choose:</p> <ul style="list-style-type: none"> * A 100 piece jigsaw puzzle * A 500 piece jigsaw puzzle | <p><i>Afternoon Session</i></p> <p>You are doing some math's activities.</p> <p>Do you:</p> <ul style="list-style-type: none"> * Play shortest and longest * Use the felt shapes * Complete a worksheet on addition | <p><i>After Lunch</i></p> <p>You play some games at the carnival.</p> <p>You play:</p> <ul style="list-style-type: none"> * Tunnel Ball * Pac Man * Bucket Game | <p><i>Go out with mother</i></p> <p>You go out with your mother. You are chatting a lot.</p> <p>Do you talk about:</p> <ul style="list-style-type: none"> * Your friends sleepover this week * Going to the movies next week * Having a play-date next week |

| | | | | | | | |
|--------|---|--|--|--|---|---|--|
| | * The Zoo | | | * A 1000 piece jigsaw puzzle | | | |
| 3:20pm | <i>Go shopping</i> You stop at the shops with your mum. Do you buy * Food * Furniture * Clothes | <i>Go to the book shop with mum</i> Do you look through: * the comedy section * the science fiction section * the action section | <i>Home from walking your dog</i> You return from walking your dog and he is dirty. Do you: * Give him a bath * Let him run around the back yard * Don't worry about it - mum will wash him later | <i>Mum arrives home</i> Your mum arrives home. Do you: * Show your mum the picture you drew * Thank her for your lunch * Tell her about your school day | <i>Visiting pet shop</i> You and your friend stop at the pet shop. Your friend wants to get a fish. Which one do you prefer: * A yellow fish * A green fish * A blue fish | <i>In the garden</i> Your mum is in the garden planting some flowers. Do you: * Help her with planting flowers * Play on your own * Ask your mum if she needs anything else done | <i>At the shops</i> You remember that you need to buy a present for your friend's birthday Do you buy your friend: * A book * A game * A movie |
| 4:50pm | <i>Home before dinner</i> You are back home from the shops Do you * Read your new book * Watch television * Play on the computer | <i>Congratulate your friend</i> You hear that your friend won the basketball competition. To congratulate your friend do you: * Ring * Text * Wait till you see your friend at school | <i>Drink with friends</i> You meet your friends and have a cold drink together. Do you have: * Ginger ale * Milkshake * Ice tea | <i>Back home</i> While outside rain forces you to go inside. Do you: * Take a warm shower * Change your clothes * Drink tea | <i>You are home now</i> You change into casual clothes. Do you then: * Take your brother to the park to play on the swings * Play with your dog * Help mum prepare dinner | <i>Dad comes home from work</i> When your dad comes home, he wants to show you his new work laptop. Do you: * Help him choose a nice screen saver * Ask him what games he has * You are not interested in his new computer | <i>Mum starts cleaning the house</i> Your mum starts cleaning the house. Do you: * Shake the doormat * Clean the mirror in the bathroom * Dust the book case in the living-room |
| 6:20pm | <i>Dinner</i> Your family decides to go out for dinner It is your choice. | <i>Dinner</i> Main course is a casserole. Do you have your casserole with: | <i>Dinner</i> You and your friend are having dinner at your place. For dessert, you have: | <i>Dinner</i> Your mum has prepared a beef stew. Do you: * Really enjoy it | <i>Dinner</i> Your Dad prepares a salad. Does the salad come with: * Roast beef | <i>Dinner</i> You sit down with your family to have your favourite meal. For dinner, do you | <i>Dinner</i> You sit down to have dinner with your family Do you have: |

| | | | | | | | |
|--------|---|--|--|--|--|--|--|
| | <p>You decide on:</p> <ul style="list-style-type: none"> * Italian * Vietnamese * Greek | <ul style="list-style-type: none"> * Rice * Pasta * Potatoes | <ul style="list-style-type: none"> * Chocolate pudding * Fruit salad * Cheesecake | <ul style="list-style-type: none"> * Not like it, but your mum forces you to eat half of it * Eat it but not really enjoy it | <ul style="list-style-type: none"> * Chicken * Lasagna | <p>have:</p> <ul style="list-style-type: none"> * Roast chicken and potatoes * Spaghetti and meatballs * Curry chicken and rice | <ul style="list-style-type: none"> * Pasta with bolognaise sauce * Pasta with carbonara sauce * Pesto pasta |
| 7:50pm | <p><i>Finished Dinner</i> You really enjoyed the meal. After the meal you decide to:</p> <ul style="list-style-type: none"> * Thank the waiter * Have dessert * Sit and chat with your parents | <p><i>Hot chocolate</i> Your Dad makes you a cup of hot chocolate. Do you then:</p> <ul style="list-style-type: none"> * Wash the cups * Have a chat with your Dad * Have another cup of hot chocolate | <p><i>After dinner</i> You feel like listening to music from the movies. Do you listen to:</p> <ul style="list-style-type: none"> * The lion king * Frozen * Lego movie music | <p><i>After Dinner</i> Your parents want to play a board game With you Do you choose:</p> <ul style="list-style-type: none"> * Monopoly * Cluedo * Checkers | <p><i>After Dinner</i> You practice your spelling words for the week Do you:</p> <ul style="list-style-type: none"> * Get them all correct * Only get half correct * Need to practice more as you didn't get any correct | <p><i>After Dinner</i> Your parents will do the dishes today During this time do you:</p> <ul style="list-style-type: none"> * Read a book * Play a board game with your brother * Play with the ball in the yard | <p><i>Cleaning up</i> Your parents ask you and your brother to help with the dishes. Do you:</p> <ul style="list-style-type: none"> * Fold your arms and say you already helped before dinner * Wash the dishes * Help your brother with the dishwasher |
| 9:20pm | <p><i>Bedtime</i> Its late and you are tired Do you:</p> <ul style="list-style-type: none"> * Go straight to sleep * Read a book in bed * Have a shower before going to bed | <p><i>Tidy up your room</i> You tidy your room and realise that you can't find your homework book Do you:</p> <ul style="list-style-type: none"> * Ask your mum if she has seen your book * Search for your book * Not look for your book | <p><i>Prepare for bedtime</i> You ask your mum if your friend can stay for a sleepover. You and your friend decide to:</p> <ul style="list-style-type: none"> * Watch your favourite movie * Play video games * Sit around and talk | <p><i>Time to go to bed</i> Your mum looks at her watch and tells you to go to bed. Do you then:</p> <ul style="list-style-type: none"> * Go straight to sleep * Start talking with her to stay up longer * Go in your room and read a book before falling asleep | <p><i>Bedtime</i> It is late and your parents want you in bed. Do you:</p> <ul style="list-style-type: none"> * Go to bed but can't sleep * Fall asleep immediately, * Start a conversation with your parents to stay up longer | <p><i>Watch television</i> You watch television with your parents. Your preference is:</p> <ul style="list-style-type: none"> * A funny movie * Sports channel * Kids movie | <p><i>Family outing</i> Your family decides to go and grab an ice cream after dinner. Which flavour do you choose:</p> <ul style="list-style-type: none"> * Chocolate * Banana * Strawberry |

APPENDIX G

REWARD FOR REMEMBERING

| | | | |
|--|--|--|--|
| | | | |
| | | | |

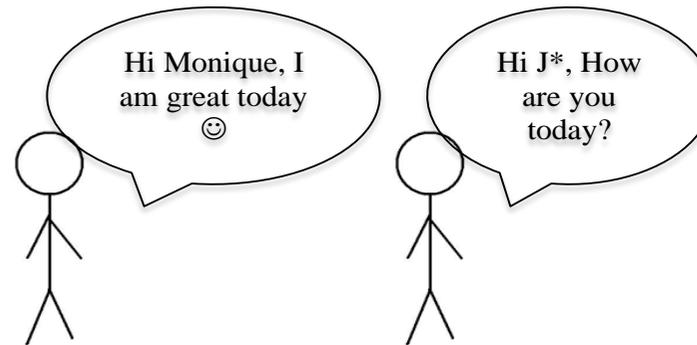
APPENDIX H

| | Trial Day | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|-----------------|--|--|---|---|--|--|---|
| Event Task | (1) Buy some pencils for school when shopping | (5) Collect your trophy for running while you are at Sport class | (9) Ask Alex about your missing school book when you meet | (13) Change your home reader book in your spare time | (17) Pack your red folder into your schoolbag during math's activities | (21) Put your rubbish in the bin when you go to play games at the carnival | (25) Pick up some new crayons while you are out with your mother |
| Event Task | (2) Hand school note to parents when home before dinner | (6) Buy a notepad for your friend when you next go shopping | (10) Tidy up your room for your friend when you return home after walking the dog | (14) Go to the swimming pool with your friends when your mum comes home | (18) Give your parents your school report to sign when you get home | (22) Meet your friends for a play when your dad comes home from work | (26) Take the washing out from the washing machine when mum starts to clean the house |
| Time Task | (3) At 10:30am help setup school hall | (7) At 7:30pm you need to phone your dad | (11) Go to the dentist at 2pm | (15) Go to see Mrs Wagstaff at 12pm for spelling | (19) Meet your friends for ice-cream at the cafe at 3:00pm | (23) Go with your friend to the canteen at 12pm midday to buy a treat | (27) You look after your brother at 12pm midday who is very grumpy |
| Time Task | (4) Phone your friend at 8pm to see if they will be at school tomorrow | (8) Go to the doctor's at 5pm to receive an injection | (12) Go to the cinema with friends at 5:00pm | (16) Pack your art things at 8pm for tomorrow's art class | (20) Water the plants in the house at 7:30pm | (24) Take your dog to the vet for surgery at 3pm | (28) Watch some fireworks at 8pm |
| Distractor Task | (1) Wash your dog | (5) Pick up your birthday parcel from the post office | (9) Do your home work | (13) Bring your brothers swimmers to the pool | (17) Go to Luna park with your family | (21) Help mum to weed the garden | (25) Go with your parents to pick up your uncle from the airport |
| Distractor Task | (2) Borrow a DS from your friend | (6) Empty out the dishwasher | (10) Bring the washing in from the clothes line | (14) Go to the circus with friends | (18) Go to the doctor's for a blood test | (22) Pack your school lunch | (26) Camp out in the backyard with your brothers |
| Distractor Task | (3) Go to the doctor's to remove your stitches | (7) Return your jacket to your best friend | (11) Send out invitations for your birthday | (15) Practice your music home work | (19) Change into casual clothes | (23) Go to your friends birthday party | (27) Fold the clean clothes |
| Distractor Task | (4) Buy a birthday present for your aunt | (8) Tell your friend about the certificate you were awarded | (12) Go to your private tutor | (16) Get your parents to sign the school excursion note | (20) Go bowling with your friends | (24) Clean the bathroom | (28) Return the DVD to the movie shop |

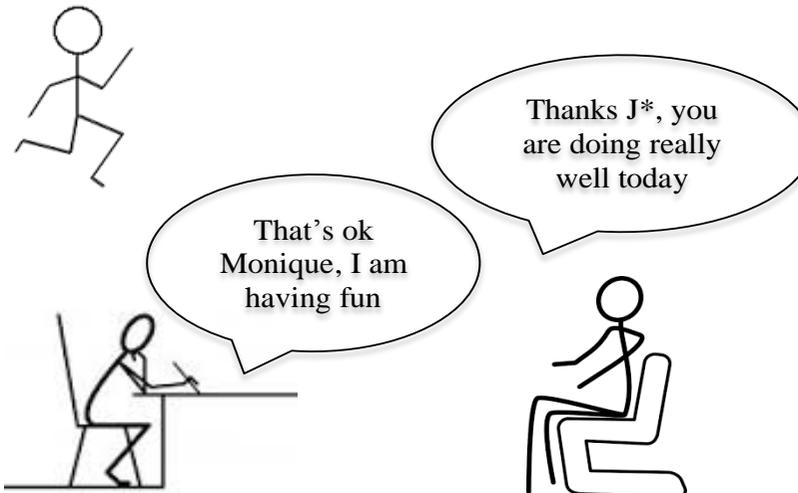
APPENDIX I

Monique is coming at 10am for one last time to play her game.

When Monique arrives I say hi to Monique



No running away and hiding



I will play the game by Moniques rules:

1. Reciting tasks when required
2. No rushing

NOTE: The original social story was hand written, for the purposes of this thesis it has been converted to a word document

* Denotes name withheld.