

Working Memory Constraints on Listening Comprehension in Adolescents with
Traumatic Brain Injury

A Thesis in partial fulfilment of the requirements for the Degree of Master of
Speech Language Therapy in the University of Canterbury

Ruth M. A. Ramsay

Department of Communication Disorders

College of Science

University of Canterbury

March, 2010

The material presented in this thesis is the original work of the candidate except as acknowledged in the text, and has not been previously submitted, either in part or in whole, for a degree at this or any other University.

Ruth M. A. Ramsay

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Acknowledgements

The author would like to sincerely thank Dr. Catherine Moran, Dr. Megan McAuliffe and Dr. Emily Lin for their support in developing and completing this study. Their expertise throughout this process has been invaluable. Thank you to the participants and their families for your willingness to be a part of this research. Your contribution made this study possible and is very much appreciated. Thank you to my work colleagues and fellow Masters students for support and advice. I also would like to thank my husband, Kelland Ramsay, for his unwavering confidence in my ability to achieve this goal. His love and the love from family and friends has been a much needed support over the last two years.

Abstract

This study investigated the effects of working memory constraints on the comprehension of expository texts by adolescents with severe Traumatic Brain Injury (TBI). The performance of adolescents with TBI will be compared against a group of typically developing (TD) gender and age-matched peers. The research questions are: (1) How does the performance of adolescents with TBI compare to typically developing gender and age-matched peers on tasks examining comprehension of expository texts?; and (2) Does comprehension of expository text decrease when working memory constraints are increased for adolescents with TBI? Fifteen participants will participate in the study. One group of five adolescents with severe TBI and a second group of ten gender and age-matched typically developing adolescents without TBI completed a battery of assessments including: Test of Nonverbal Intelligence 3rd Edition (TONI-3), Clinical Evaluation of Language Fundamentals 4th Edition (CELF-4), Peabody Picture Vocabulary Test 3rd Edition (PPVT-3) and the Working Memory Span Task (Tompkins et al 1994). All participants also completed an experimental task which involved listening to an expository passage and answering comprehension questions. Scores were then submitted to statistical analysis using ANOVA methodology to determine the significance of any within and between group differences.

Results showed that there was no significant group by task interaction effect. The study did show that there was a significant difference between the TBI and TD groups on the measure of working memory.

Results of the study will enhance our understanding of how adolescents with TBI comprehend expository information. This study will also help to create a foundation for further research into this area which is critical for student's success in secondary education.

Keywords: Traumatic Brain Injury, comprehension, working memory

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CHAPTER 1

LITERATURE REVIEW

1.0 Introduction

A large number of New Zealand children and adolescents are at risk of significant language and academic difficulties due to traumatic brain injury (TBI). McKinlay et al. (2008) reported annual TBI incidence rates of 1.1% to 2.4% for people aged 25 years and younger. Although recovery from relatively minor TBI may take several days or weeks, people with moderate to severe injuries may experience symptoms for three (Chapman & McKinnon, 2000) to 36 months (Levin et al., 2004) after injury. Furthermore, many children and adults with TBI are also reported to experience life-long cognitive difficulties (McCabe & Bliss, 1996).

To date there has been minimal research into these individual areas of cognitive deficit for adolescents with TBI, whether they sustained their head injury as a child or in the teenage years. Youse & Coelho (2005) and Ewing-Cobbs et al. (1998), state that to identify deficits within language functioning for this population, language needs to be studied at a discourse level and a variety of discourse genres need to be studied. This current study looks into one specific discourse genre, expository discourse.

Another identified deficit for adolescents with TBI is listening comprehension (Moran & Gillon, 2004). For a person to successfully comprehend what they hear they need to be able to hold the information long enough to process it for meaning (Montgomery et al, 2008). This is the role of working memory. Montgomery et al (2008) also state that working memory can be made to work harder if constraints are placed on it. This study aims to tax working memory by breaking down the expository discourse into two further forms, active and passive.

The aim then is to enhance our understanding of how adolescents with TBI comprehend expository discourse through three main aims:

1. To compare the performance of adolescents with severe TBI against a group of typically developing gender and age-matched peers on an expository discourse comprehension task.
2. To examine the effects of working memory constraints on the comprehension of expository texts by adolescents with severe TBI.
3. To explore the relationship between working memory and listening comprehension in TBI.

1.1 Ongoing Problems Caused by TBI

The ongoing difficulties resulting from a TBI include a range of deficits. According to Conklin et al (2008) these can be seen in the areas of cognitive functioning, attention, executive functions, behavioural and academic difficulties. Academic achievement is also listed by Levin and Hanten (2005) as being affected following moderate to severe TBI. They go on to add that emotional disturbances are also apparent and when combined with a lack of, or reduced ability to adapt, due to damaged executive functions, this deficit presents as difficulties in everyday situations.

Social understanding is another area that is likely to be impaired and cause ongoing difficulties (Levin and Hanten, 2005). Social competence requires a person to be able to take another person's point of view, or at the very least to understand that different views exist. To be able to interpret the actions and thoughts of someone else is key to building peer relationships throughout a lifetime. Children with a TBI have difficulty interpreting ambiguous thoughts and actions from others (Levin and Hanten, 2005). This can result in an inappropriate response during listening interaction or task when the child has missed important visual, facial or non verbal cues indicating another's message. The child is also expected to regulate their own behaviour. If they respond inappropriately there is an expectation that they will be able to reflect on their actions and then not repeat them, instead replacing them with more socially acceptable actions. Levin and Hanten, (2005) reported that this area of behavioural self-regulation is also impaired following TBI. Hart et al (2005) looked at thirty-six participants with moderate to severe TBI. When compared to non head injured controls, the TBI group exhibited impaired self-awareness (ISA). They determined that this impairment was related to damage to the executive functions of cognition. The impairments to interpreting messages from others and then deciding on an acceptable

response create chronic difficulties in following instructions and gaining necessary skills across environments of family, school and work for someone with TBI.

1.2 Language Difficulties following TBI

Children who experience TBI are at risk of experiencing a number of significant language difficulties (Chapman et al., 2001). Brookshire et al (1999) stated that these difficulties affect children in the acute phase of TBI and some continue past one year of onset. They listed the following deficits in the acute phase: dysnomia, object naming latency, speech fluency issues, writing to dictation, copying written sentences, writing well structured stories. These language problems arising from moderate to severe TBI (Catroppa, 2004) are associated with changes in frontal lobe processing of higher level cognitive tasks of attention, sequencing, planning, problem solving and memory (Hart, 2005; Levin, Song, Ewing-Cobbs, Chapman, & Mendelsohn, 2001; Schmitter-Edgecombe & Bales, 2005).

These higher level cognitive tasks are defined as a group as executive functions. Levin and Hanten (2005) describe executive functions as those that direct more individual skills of language, memory, perception and motor skills when a person is in the process of creating, carrying out and reaching goals. Executive functions help to organise incoming and outgoing thought and action as well as deal with any interference. For a person with TBI, a number of the areas classified as executive functions can be impaired. Levin and Hanten (2005) go on to describe each of these areas. Those that are relevant to language difficulties in TBI are: planning, metacognition, decision making, and behavioural self regulation. Planning is used to think ahead to what the next step may be. In education this ability is used every day in problem solving, answering questions and goal setting, to name a few. In children with TBI, the more complex the planning, the harder it is for them to complete and errors increase.

Metacognition is self-regulation and is required for control of action. Like the other abilities listed within the executive functions, it too develops with age. Metacognition is needed to monitor the amount of mental resources any one task requires. In TBI this ability is impaired and as a result the child will often incorrectly estimate how easily something can be learned. This error in metacognition leads to failure of the task. Decision making is another area of possible impairment. Cognitively, to make a decision, irrelevant information must be discarded and any other known information used effectively to inform this decision. Therefore, to make a decision, a number of factors need to be considered. They may also be unable to adapt cognitively within a situation according to Levin and Hanten (2005). This means that they may have trouble choosing how to best approach a task based on incoming information. Gersten et al. (2001) commented that learning impaired students do not approach different types of text in a planned way. Instead, the students randomly take information without plan resulting in poorer retell ability. This approach makes language comprehension difficult for learning impaired adolescents.

Dennis and Barnes (2001) reported that basic language skills such as naming and articulation are often impaired during the acute phase following childhood TBI. However, during the chronic phase, impairment in the higher language functions such as text comprehension and discourse skills become most apparent during the chronic phase. Researchers also suggest that cognitive deficits apparent soon after injury, will remain and further deficits may only appear as children develop (Biddle, McCabe & Bliss, 1996). Therefore, young children experiencing TBI during primary school years may have different rehabilitation needs compared to adolescents or adults experiencing TBI. For instance, as a child with TBI ages, developing skills such as syntactic development, vocabulary expansion and discourse production and comprehension may become more challenging. In addition, children who

demonstrate difficulties with developing language skills may require different strategies than those that were helpful earlier on in the rehabilitation process.

1.3 Language Comprehension and TBI

One area of language that may be affected is language comprehension. As previously mentioned, studies show that following the acute stage higher language function impairment, such as text comprehension, becomes most apparent (Dennis and Barnes, 2001). This is a result of the overall reduction of cognitive linguistic ability according to Brookshire et al (1999). Catroppa and Anderson (2003) also stated this reduced linguistic ability as a possible reason for impairment in language comprehension. This study found that participants with severe TBI showed language difficulties persisting up to twenty-four months post injury. The impairment in language comprehension was found to affect complex language processes. Dependent on the age of injury, more simple language abilities were left intact.

Moran et al (2006) looked at comprehension of proverbs in the adolescent TBI population. They stated that high level cognitive processing is required to comprehend figurative language and that this ability to understand this type of language develops throughout childhood and adolescents. Adolescents need to have learned how to draw on existing skills during comprehension tasks such as determining word meaning, context and any general knowledge they may have on the topic. Moran et al (2006) go on to state that if a TBI is sustained as a child, this ability to comprehend language may be impaired. They also link comprehension of figurative language to academic success such as reading and listening. If a student is not able to follow verbal instructions or retain information in they receive in class they are disadvantaged in the learning environment and as stated, academic performance will suffer.

Moran and Gillon (2004) also stated that listening comprehension is an area of deficit for adolescents with TBI. In their study, adolescents were compared to a control group for measures of standardised language assessments including listening comprehension. The TBI participants did perform more poorly than the control group but there were differences of ability within the TBI group. They found that the more severe the TBI, the more reduced language comprehension was however, there was not consistently poor performance on all measures. One TBI participant performed well on the language measures. This then prompted the researchers to look for other possible contributing factors such as working memory functioning. They felt that it was important to look at overall ability in language comprehension instead of focussing on only linguistic or cognitive ability. Three variables were identified as important to language comprehension in TBI: Core language skills, processing demands, storage demands. Comprehension will be successful if all three of these areas are working normally. If, however, there is a breakdown in any or all of the variables comprehension will be compromised. Moran and Gillon (2004) called for further investigation into the possible interaction of these variables.

1.4 Language Comprehension at Discourse Level

Comprehension at the discourse level is important to understand because of its importance in both educational and social activities (Levin and Hanten, 2005). Secondary school education requires adolescents to understand, create and organise both written and spoken discourse genres (Chapman et al., 2001). Discourse comprehension is a complex task according to Levin and Hanten (2005). They stated that this level of comprehension requires a number of cognitive abilities to be working in conjunction with each other. Montgomery et al. (2008) reported that the parts of language at the discourse level need to be temporarily held long

enough to be recognised and processed. Executive functions previously discussed by Conklin et al. (2008) are also needed to filter irrelevant information and prioritise important information. The combination of these abilities becomes more sophisticated as a child ages. Following TBI however, the ability to process relevant information within discourse and then to be able to recall it later on is reduced (Hay and Moran, 2005). This then creates gaps between skill levels for the child with a TBI and their peer (Biddle, McCabe & Bliss, 1996). The peer is gaining skills in this area effortlessly and at a high rate. Adolescents are expected to be able to form and comprehend different types of spoken discourse as this type of interaction is imperative for successful social participation (Kamil, 2008; Levin and Hanten, 2005). These language comprehension deficits then can impact dramatically on this type of participation for adolescents.

Brookshire et al. (1999) stated that following a severe TBI children have difficulty with discourse on a number of levels. These can include understanding the overall meaning or theme of the text, organising information and deciding on the amount and complexity of language to use when creating discourse. The narratives created by these children have fewer words or less complexity, poor structure and a lack of cohesion of thematic roles or ideas. Hay and Moran (2005) stated that previous studies had found that children with TBI were not able to recall as much information as their non head injured peers when it came to a story retell task. They also noted that the TBI group's language was less complex. Hay and Moran (2005) also described a new direction of research into expository discourse however, at the time no research had been done with this type of discourse and participants with TBI. They cited research that had been done was with children, twelve to fifteen years of age, with language learning difficulties (LLD). The LLD group and a control group of age-matched peers were asked to recall two expository lectures. One was in a causation style and the other

was comparison. Both groups performed better on the causation lecture than the comparison but overall the non-LLD group performed significantly better. They produced more complex language, at a faster rate and included more of the information from the lectures than the LLD children.

Expository, or descriptive discourse is the main form of verbal and written instruction in the secondary school system (Kamil, 2008; Gersten et al. 2001). Expository discourse is used when providing verbal and written instructions, presenting factual information and teaching sequences of steps and activities. Gersten et al. (2001) stated that an adolescent with language deficits is likely to struggle to understand, retain and interpret this type of discourse. They go on to say that there are three conclusions that can be drawn from research thus far:

Understanding of text structure is acquired with age, certain text structures are easier to comprehend; being able to figure out what the text structure is and then use it is imperative for comprehension of expository text. They reported that expository text was more challenging to understand than narrative due to the fact that expository contains more abstract arguments than the events in a narrative passage. Hay and Moran (2005) looked at written and spoken expository discourse production in adolescents as well as narrative discourse. They found that the participants performed more poorly on the expository tasks when compared to the narrative. Studies call for research utilising this type of text genres to determine specific characteristics of language comprehension deficits in adolescents with TBI (Youse & Coelho, 2005; Ewing-Cobbs et al., 1998).

1.5 Working Memory and Language Comprehension

An explanation for adolescents with TBI experiencing language comprehension difficulties is working memory (Moran, Nippold, & Gillon, 2006). Working memory is one of the

cognitive functions known to be damaged as a result of TBI (Chapman et al., 2006; Moran & Gillon, 2004; Moran, Nippold, & Gillon, 2006; Roncadin, Guger, Archibald, Barnes, & Dennis, 2004; Youse & Coelho, 2005). Moran, Nippold & Gillon (2006) defined verbal working memory as a limited capacity system used for simultaneously storing and processing information. This system is responsible for the allocation of resources for processing information necessary for language comprehension. Montgomery et al (2008) stated that working memory allows retention of incoming information while cognitive tasks are being performed such as verbal reasoning or comprehension. This study goes on to explain that there have been a number of working memory models proposed and researched. There is however, within these models, three agreed upon components of working memory. They are the phonological short-term storage buffer or loop (PSTM), attentional resource control/allocation mechanism and lastly, processing speed.

Montgomery et al (2008) go on to describe each of these components of working memory. The phonological short-term storage buffer has a limited capacity for the rehearsal of incoming language. Speech comes in to this buffer but will not be held for long and is easily lost if not processed. As the listener is cognitively sequencing the speech for comprehension, the words are held by the PSTM. As children age this buffer increases in the capacity it can hold. The attentional resource control/allocation mechanism supports processing and storage. The listener has to be able to divide attention while controlling these two cognitive activities. According to Baddeley (2003) attentional control is part of the central executive and is one of the main reasons that difference in working memory performance exists between subjects. Processing speed is just that; the rate or efficiency at which information is processed. This is a static trait but does improve with age. Once it reaches maturity in young adulthood, over a set period of time a faster rate is able to process greater amounts of information than a slower

rate. This slower rate becomes an issue when the information briefly stored in the PTSM has faded and is no longer available for processing. Also, more complex tasks take longer to process so if the rate or efficiency is already reduced, again, information is lost before it is able to be processed for comprehension.

The three components of working memory above work together to provide the initial point of processing for incoming information and are therefore responsible, in large part, for academic success. They link cognitive and academic skills according to Levin et al (2004). They state that reading, writing and understanding of auditory language are tied to working memory. Moran & Gillon (2004) also commented that listening and reading comprehension are linked to working memory. Therefore, if TBI damages working memory functions, language deficits will be present.

There is evidence that children with TBI experience working memory difficulties as well as language deficits (Chapman et al., 2006; Moran, Nippold, & Gillon, 2006; Roncadin, Guger, Archibald, Barnes, & Dennis, 2004; Youse & Coelho, 2005). It is also known that language comprehension is influenced by working memory. Therefore, it is expected that if working memory is impaired, parts of language comprehension will be also. In general, working memory is affected by the demands placed on it and will allocate resources as needed to comprehend, retrieve and learn information. Youse & Coelho (2005) explain that if the demands on the system increase then the rate of processing must also increase to deal with the higher demands. When this occurs accuracy eventually decreases. It is extrapolated then that any damage to the working memory system will have the effect of reducing processing speed and efficiency for discourse comprehension. These deficits are likely to result in comprehension difficulties in both written and spoken language (Moran & Gillon, 2004).

Studies using narrative discourse genres have reported adolescents and children with TBI performing poorly on comprehension tasks (Chapman et al., 2006; Chapman et al., 2004; Dennis & Barnes, 2001; Ewing-Cobbs et al., 1998; Hay & Moran, 2005; Youse & Coelho, 2005).

The performance of working memory during written or spoken language comprehension tasks can be observed by varying the constraints placed upon the system (Youse & Coelho, 2005). Examples include the salience of the critical information, syntax, redundancy and density of clauses. These variables can be increased or decreased to measure their relative effect on comprehension. One syntactic structure that has received considerable attention is the relationship between passive sentence comprehension and working memory.

Montgomery et al (2008) stated that syntactic structures such as passive sentences are well within a typically developing child's ability to comprehend. They stated that by about age six this and other structures such as pronominal and reflexive sentences are reliably understood because typically developing children show increases in working memory capacity as they grow. Turkstra and Holland (1998) hypothesised that a normally developing group would perform equally as well on receptive syntax tests whether the working memory constraints were high or low. This is because these participants had no deficits within the working memory system and were able to utilise the system to its fullest ability.

Language impaired adults have also been studied with regard to passive sentence comprehension. Luzzatti et al (2001) studied eleven agrammatic patients and compared them to sixteen fluent aphasia patients and ten control subjects. Part of the study was to determine if passive structures would result in reduced comprehension. They found that it did for five of

the agrammatic patients and five of the fluent aphasic patients as well. Wright et al (2007) also studied adults with Aphasia. This study looked at a group of nine adults with aphasia on measures of phonological, semantic and syntactic comprehension. They were interested to see if they could find a measure for working memory that would identify where the breakdown is occurring in language impaired adults. They stated that the traditional test used for working memory with this population has been the Daneman and Carpenter's Reading Span Test (1980) however, this test requires phonological, semantic and syntactic information to be held and processed at the same time. The researchers used *n*-back tasks to look at individual areas of linguistic information, phonological, semantic and syntactic. They also wanted to investigate a possible link between working memory and auditory comprehension. The study found that the participants had more difficulty comprehending syntactically complex sentences in the form of passives and object-relative and that as working memory was taxed auditory comprehension decreased.

Montgomery & Evans (2009) stated that information presented in the passive form increases the demands on working memory. In English, passive sentences violate the canonical word order which forces the listener to cognitively hold the subject and object and perform argument movement to assign correct thematic roles. Montgomery & Evans (2009) go on to explain that these demands mean that working memory experiences an increase in load and consequently speed of processing and allocation of resources/attention are taxed. The system has to work harder and faster to be able to cope with the higher demands placed on it. In the TBI population, where working memory is impaired, constraints placed on working memory have shown to reduced processing speed and overall storage capacity (Hay and Moran, 2005; Youse & Coelho, 2005; Montgomery et al., 2008). This study aims to answer three key questions: 1) Do adolescents with Traumatic Brain Injury perform more poorly than

adolescents without brain injury on a listening comprehension task? 2) Do adolescents with TBI and adolescents without TBI perform more poorly on a listening comprehension task when the working memory demands are increased; and 3) Is working memory related to performance on a listening comprehension task? It is hypothesised that adolescents with traumatic brain injury will perform more poorly on listening comprehension than typically developing peers, especially when working memory demands are increased. It is also expected that they will perform more poorly on the language measures and the working memory task.

CHAPTER 2

METHOD

2.1 Design

This study utilised an experimental between subjects research design. The independent variable was the level and variety of constraints placed on working memory during comprehension tasks involving expository texts. The dependent variable was the participants' performance on the comprehension tasks.

2.1.1 Participants

A total of 15 participants, across two groups, participated in the study. The first group of five were adolescents with severe Traumatic Brain Injury (TBI) (aged between 12 and 19 years of age; mean = 15;6). The second group were ten typically developing gender and age-matched adolescents without TBI (TD) (aged between 12 and 19 years of age; mean = 15;9).

Participants were all male and spoke English as their first language. All participants were identified by their schools in the Christchurch metropolitan area as possible participants.

They were then contacted by the school with an information sheet. The parents or caregivers of the adolescents decided if they would give consent for their children to participate.

Ethics approval was sought and granted by The University of Canterbury Human Ethics Committee. Information sheets were provided to possible families. Permission was then sought from participants and parents/care givers of participants. (See Appendix A)

2.1.2 Adolescents with TBI

The five participants with TBI were initially identified by their parents or caregivers as having sustained a traumatic brain injury. Confirmation of the diagnosis of TBI was through the accident Compensation Corporation of New Zealand (ACC) which provided funding to the participants for rehabilitation following TBI. All participants who had a TBI were

receiving individualised programs at their schools along with teacher aide support.

Biographical information that included age, age of injury, cause of injury and ethnicity was collected and is presented in Table 1. The participants without TBI were matched by gender and age. They were also matched by school where possible to attempt to account for levels of socioeconomic status.

Table 1 Participant Demographics

Participant	Gender	Age at testing TBI	Age at injury	Severity of injury	Mechanism of injury
1	M	15;3	4;0	Severe	Bike vs. Car
2	M	12;10	3;0	Severe	Fall
3	M	16;10	11;0	Severe	Bike vs. Car
4	M	19;3	0;3	Severe	Illness
5	M	13;9	4;0	Severe	Fall

Note: *TBI = Traumatic Brain Injury*

2.1.3 Age Matched Peers

Age-matched, non-brain injured participants were recruited through the schools that the individuals with TBI attended. The typically developing (TD) participants were matched on age and gender. There was no history of traumatic brain injury or other developmental or acquired learning or language disorder. In addition, all TD participants performed within the normal age limits on a battery of standardised language tests.

2.1.4 Exclusions

Participants were excluded from the study if English was not their first language or if they had a visual or hearing impairment that would hinder completion of the standardised testing or the experimental tasks.

2.2 Procedure

Participants were seen either at their home, school, or at The University of Canterbury Department of Communication Disorders. The order of standardised assessment, and experimental tasks was counter balanced to limit order effects. The assessments were administered by the author. The experimental tasks were played on a tape recorder (SONY TCM-5000EV) to ensure consistency of delivery to each participant. All sessions were either videotaped or audio taped on (SONY TCM-5000EV). Participants were able to request breaks at anytime during the sessions. Participants were seen for a maximum of three individual sessions lasting approximately one hour each. Due to access difficulties the period of time that the TBI participants were seen across varied.

2.2.1 Ancillary Tests

After establishing background information with a case history, four measures were taken from every participant to show language and working memory abilities. These were receptive and expressive language measures (Clinical Evaluation of Language Fundamentals – 4 and the Peabody Picture Vocabulary Test 3rd Edition) along with problem solving (Test of Nonverbal Intelligence) and a working memory measure (Working Memory Span Task, Tompkins et al, 1994).

Case History

This was a brief interview to gather information regarding date of birth, severity of injury and areas of difficulty as reported by the participant and the family.

Test of Nonverbal Intelligence 3rd Edition (TONI-3)

The TONI-3 (Brown, Sherbenou & Johnsen, 1982) was administered to all participants to determine baseline nonverbal intelligence and reasoning ability. This test has no verbal instruction. Participants are shown how to choose the correct missing piece from a pattern and then are expected to use that technique throughout the rest of the test items. This test was used for verification of normal intelligence as required for the TD participants to be part of the control group.

Clinical Evaluation of Language Fundamentals 4th Edition (CELF-4)

The CELF-4 (Semel, Wiig & Secord, 2003) is a standardised language assessment that evaluates receptive and expressive language for children and adolescents aged 5 to 21 years. The following core language subtests were used to gain a raw score which was then converted to a standard score and a core language score for each participant: Concepts and following Directions, Recalling Sentences, Formulated Sentences, Word Classes Total, Word Definitions

Peabody Picture Vocabulary Test 3rd Edition (PPVT-3)

The PPVT-3 (Dunn & Dunn, 1997) is a standardised measure of receptive vocabulary. A word is spoken by the examiner and the listener chooses the meaning among four pictures. The PPVT-III was administered to all participants.

Working Memory Span Task (Tompkins et al, 1994)

This task was administered to all participants to gain a measure of working memory. They were asked to answer true or false to statements and then recall the final words in that group of statements. The first set requires two final words to be recalled. The sets then increase in difficulty with the last set requiring five final words to be recalled. Points were awarded for each of the final words recalled. (See Appendix D)

E.g. *Set 1*

You sit on a chair

Trains can fly.

The results of ancillary testing are detailed below in Table 2.

Table 2 Participant Performance on Ancillary Tests

Participant	PPVT-3		TONI-III		CELF-4		Working Memory	
	TBI	TD	TBI	TD	TBI	TD	TBI	TD
1	104	176	5	38	44	109	20	36
2	127	152	13	128	81	109	20	31
3	117	171	14	107	40	120	4	33
4	110	160	18	90	44	114	20	33
5	123	176	12	83	48	104	19	30
6		172		100		117		42
7		167		135		108		37
8		180		83		112		35
9		187		115		104		41
10		167		110		114		34

Note. Participants were 5 TBI and 10 TD; PPVT-3 = Peabody Picture Vocabulary Test 3rd Ed; results shown are raw scores; TONI-3 = Test of Non Verbal Intelligence 3rd Ed; results shown are quotients; CELF-4 = Clinical Evaluation of Language Fundamentals 4th Ed.; results shown are Index Standard Scores; Working Memory results shown are raw scores; TBI = Traumatic Brain Injury participants; TD = Typically developing participants; age and gender matched.

2.2.2. Experimental Task

Ten pairs of expository experimental passages and five pairs of filler passages (thirty passages in total), also expository, were created by the author. These were all based on non-fiction reading material intended for the intermediate to high school aged child (11 years to 18 years of age).

Each pair of experimental passages had the same information, however, one passage in each pair was written in the active form (low working memory demands) and the other was written to include passive sentences (high working memory demands) (See Appendix B). The passive form is derived from the active form. In a passive sentence the active subject is optional or introduced with 'by' and becomes the subject. Semantic roles stay constant with promotion of object and demotion of subject (Gennari & MacDonald, 2008).

The pairs of passages were separated so that they were not presented during the same session. Each participant listened to a passage and was then presented with a series of questions relating to the information within that passage. The questions were also presented aurally via tape recording. No writing was required of the participant. Responses to questions for the passages were scored as correct (1 point) if comprehension of the content was demonstrated. The participant was not expected to answer verbatim.

2.3 Scoring

All answers were written verbatim by the author on the individual score sheet for that participant. Each passage was then scored out of a possible seven points with a possible overall total for the set of seventy (ten active and ten with passives). Totals were listed for active and passive passages for both groups. See performance of TBI and TD groups below in Table 3.

Table 3 Participant Performance on Experimental Passages

Participant	Active		Passive		Overall Listening Comprehension	
	TBI	TD	TBI	TD	TBI	TD
1	9	59	6	61	15	120
2	13	50	22	56	35	106
3	17	55	14	58	31	113
4	21	57	24	57	45	114
5	33	56	37	55	70	111
6		53		61		114
7		54		58		112
8		58		59		117
9		64		64		128
10		51		52		103

Note: Results are shown in raw scores.

2.3.1. Reliability

An independent researcher was provided with a marking guide and trained by the author to carry out reliability checks on 10 % of the experimental tasks. Discrepancies in scoring were discussed between the author and the independent researcher to reach agreement. The interjudge reliability for the experimental tasks was 99%.

2.3.2. Statistical Analysis

Scores were submitted to statistical analysis using two-way repeated measure ANOVA to determine the significance of any within and between group differences. A t-test was performed on working memory scores for each group to determine any differences.

CHAPTER 3

RESULTS

This study aimed to answer three key questions: 1) Do adolescents with Traumatic Brain Injury perform more poorly than adolescents without brain injury on a listening comprehension task? 2) Do adolescents with TBI and adolescents without TBI perform more poorly on a listening comprehension task when the working memory demands are increased; and 3) Is working memory related to performance on a working memory comprehension task? In order to answer the questions, the study compared the performance of adolescents with TBI and their age-matched peers on a discourse comprehension task. The discourse comprehension task required participants to answer comprehension questions following presentation of two types of expository passage: one written in the active voice (low working memory demands) and one written in the passive voice (high working memory demands). Results were analysed and presented below.

3.1 Ancillary Measures

Prior to answering the key questions, results from the ancillary tasks were analysed for group differences. Results of ancillary testing indicated significant differences between the TBI and TD groups on measures of Working Memory, the Peabody Picture Vocabulary Test 3rd Ed., the Test of Non Verbal Intelligence 3rd Ed. and the Clinical Evaluation of Language Fundamentals 4th Ed. (WM: $t = 15.000, p = 0.003$; PPVT-III: $t = -10.156, p < 0.001$; TONI-3: $t = -6.815, p < 0.001$; CELF-4: Wilcoxon Signed Rank Test $W = 120, p < 0.001$). It is important to note that the sample size was small with five TBI participants and ten TD participants; $n(\text{small}) = 5$ $n(\text{big}) = 10$.

Performance on the working memory task between the TBI and TD groups was analysed using T-test. It was expected that the TBI group would perform more poorly on the working memory task when compared to their typically developing peers. A significant difference between the two groups was found ($t = 15.000, p = 0.003$). It is important to note that the sample size was small with five TBI participants and ten TD participants; $n(\text{small}) = 5$ $n(\text{big}) = 10$.

3.2 Research Questions

In order to answer the first two questions, a two by two (group x task) Analysis of Variance was carried out. It was expected that adolescents with TBI in particular, would show reduced comprehension on the listening comprehension task when compared to the adolescents without a TBI. Results from the two-way repeated measures ANOVA performed on the combined tasks score revealed a significant group effect [$F(1, 13) = 115.254, p < 0.001$] with individuals with TBI performing more poorly generally. See Figure 1. There was also task effect [$F(1, 13) = 4.703, p = 0.049$]. With regard to task, it was predicted that passages containing passives (higher working memory demands) would result in reduced comprehension compared to passages containing active sentences. This was not confirmed and the opposite effect was noted. Finally, there was no significant group by task interaction effect [$F(1, 13) = 0.0389, p = 0.847$].

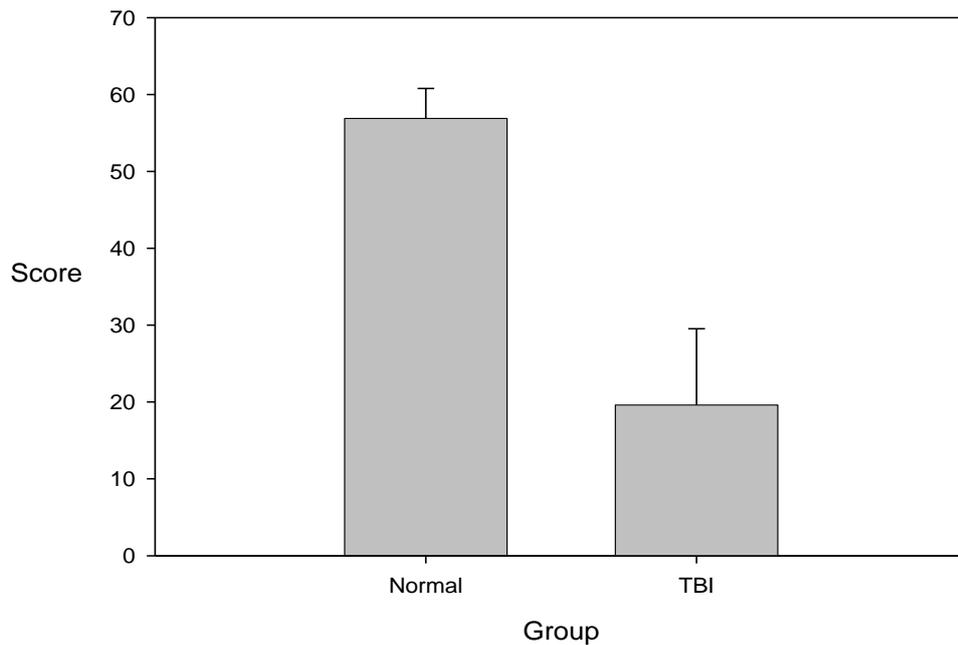


Figure 1 Comparison of Groups on Overall Comprehension Performance

Note: *Score = Overall Comprehension score, Normal = Typically Developing, TBI = Traumatic Brain Injury*

3.3 Relationship of Working Memory to Comprehension

In order to determine whether a relationship between working memory scores and the type of passage existed correlation analysis was run. There was a correlation between the working memory scores and overall listening comprehension performance for both groups . The correlation coefficient was 0.878, $p = 0.00001$. A correlation was also found between the working memory scores and the type of passage containing passives for the TD group. No correlation was found between the working memory scores type of passage for either task (active or passive) for the TBI group. Figure 2 shows the correlation coefficients for both groups.

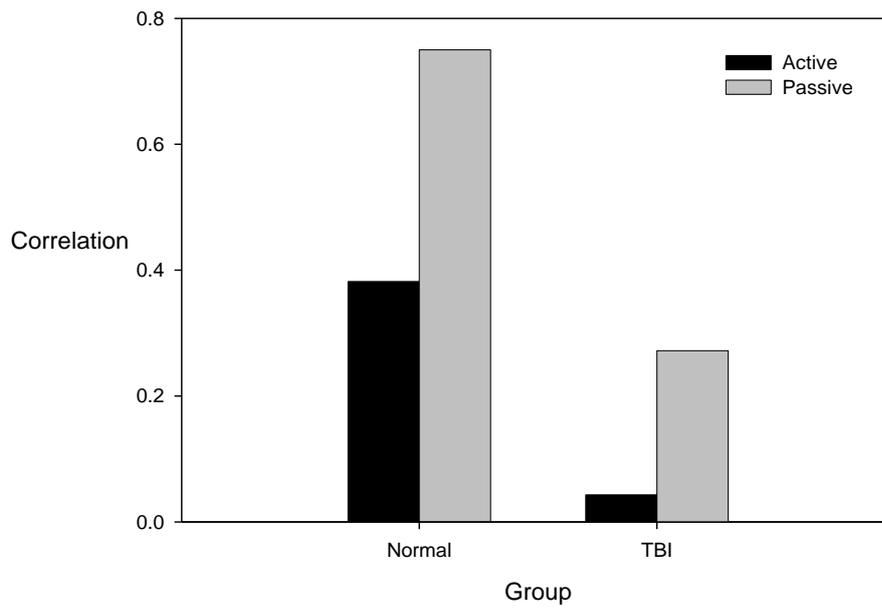


Figure 2 Correlation of Working Memory and Overall Listening Comprehension

Note: *Correlation = correlation coefficient, Normal = Typically Developing (TD), TBI = Traumatic Brain Injury*

CHAPTER 4

DISCUSSION

This study aimed to answer three key questions: 1) Do adolescents with Traumatic Brain Injury perform more poorly than adolescents without brain injury on a listening comprehension task? 2) Do adolescents with TBI and adolescents without TBI perform more poorly on a listening comprehension task when the working memory demands are increased; and 3) Is working memory related to performance on a listening comprehension task? It was hypothesised that adolescents with traumatic brain injury would perform more poorly on listening comprehension than typically developing peers, especially when working memory demands are increased. It is also expected that they will perform more poorly on the language measures and the working memory task when compared to their typically developing peers.

4.1 Findings: Group Differences

4.1.1 Language and Working Memory Measures

The results of ancillary testing indicated significant differences between the TBI and TD groups on measures of Working Memory, the Peabody Picture Vocabulary Test 3rd Ed., the Test of Non Verbal Intelligence 3rd Ed. and the Clinical Evaluation of Language Fundamentals 4th Ed. Analysis of the performance on the working memory task between the TBI and TD groups found a significant difference between the two groups ($t = 15.000$, $p = 0.003$). This confirmed what was expected from the literature about working memory and TBI. Participants with TBI also performed more poorly on standardised language measures and non-verbal intelligence testing. This is consistent with findings from Moran & Gillon (2004) and Hay & Moran (2005) where children and adolescents were found to have reduced performance on standardised measures.

4.1.2 Listening Comprehension

It was expected that adolescents with TBI in particular, would show reduced comprehension on the listening comprehension task when compared to the adolescents without a TBI.

Overall, the TBI group did perform more poorly than the control group on the listening comprehension task. Although of studies have looked at listening comprehension, few have looked at discourse (Moran & Gillon, 2004; Gersten et al. 2001; Hay and Moran, 2005). This study supports the notion that listening comprehension is reduced and extends the knowledge base to discourse comprehension. This is particularly important in that much of what students use in the educational setting is discourse of some type (Chapman et al., 2001; Kamil, 2008; Levin and Hanten, 2005).

4.1.3 Listening Comprehension and Working Memory Constraints

It was expected that when working memory constraints were increased, comprehension would decrease (Montgomery et al., 2008; Hay & Moran, 2005; Youse & Coelho, 2005).

Results of this study however, showed that both groups performed better in the passive sentences when working memory constraints were increased. This was unexpected as it was predicted that the addition of passives would constrain working memory. Montgomery et al. (2008) stated that the processing time of complex sentences is significantly slower than that of simple sentence construction. This study did not control for processing time between the presentation of the off-line comprehension questions and the answer from the participant.

This could be mean that working memory was not taxed to the point of breakdown but just taxed enough to allocate extra resources to the task thereby improving performance.

Montgomery and Evans (2009) support this hypothesis that resource allocation could be responsible for comprehension success. They found that children with specific language impairment did struggle to comprehend complex sentences, including passives, but that it was

due to the fact that they could not allocate resources fast enough to carry out the cognitive operations needed to comprehend the sentences.

Another possible explanation for the unexpected results of the passages that included constraints is familiarity. Familiarity has been shown to facilitate working memory (Gersten et al. 2001). Participants may have been relying on their general or world knowledge to support their answers. The participants were not required to answer verbatim but to demonstrate that they had comprehended the contents of the passage. For example:

Sentence: Bats fly by flapping their forelimbs, which are wings.

Question: Why can bats fly?

Possible answers: They have wings/ Flap their forelimbs/combination of both

(See Appendix C)

The answer to this question could be answered without hearing the sentence if the participant has any general knowledge about bats. Both Hay and Moran (2005) and Gersten et al. (2001) stated that world knowledge needs to be incorporated into discourse tasks both for production and comprehension. Future studies that control for familiarity are warranted. Finally, the small sample size may have meant that differences weren't shown.

4.1.4 Working memory and Listening Comprehension

Working memory was found to correlate with the overall listening comprehension scores.

This is consistent with what is expected from the literature (Moran and Gillon, 2004)

however, the finding is notable given that there was no task difference (active vs. passive).

Again, it is possible that the passive sentences did not constrain working memory as expected either due to simplicity of the sentences or familiarity.

4.2 Limitations

The sample size was small with five adolescent TBI participants and ten TD participants. This is not an unusual occurrence when studying this population. There have been other studies with small sample sizes (Hay & Moran 2005; Van Leer & Turkstra, 1999). Other studies have had fifty-five participants or more in the TBI group (Youse and Coelho, 2005; Conklin et al. 2008). Increased numbers in this present study may have resulted in greater differences between the two groups, particularly considering they were significantly different on standardised language and working memory measures.

It is well documented that traumatic brain injury participants are heterogeneous. They differ in severity of injury, time since injury, location of lesion and type of damage. In this current study, severity was reported by the family. There was also a variation in the age since injury ranging from 5;10 to 19 years which meant that similar to Hay and Moran (2005), the participants sustained their injuries at different stages of cognitive development. In this time the five adolescents had all received funding for support in the home and school as required. This included speech-language therapy and teacher aide support for all of them to varying degrees and length of time. There was no way of tracking this input to account for its possible affects on outcomes.

4.3 Clinical Implications

This area of research is relatively new. Some studies have looked at production of narrative and/or expository text (Hay & Moran, 2005). Other studies such as Moran & Gillon (2004) have investigated listening comprehension within language measures but there has been no study to date that examined listening comprehension and expository text. Given the difficulties the individuals with TBI had on the comprehension tasks, discourse comprehension should be included in a battery of language test for people with TBI.

With regard to intervention, clinicians and teachers often attempt to find ways to facilitate comprehension. One possible way may be by simplifying the voice of the sentence (active vs. passive). However, this study does not support this strategy. Other strategies for facilitating comprehension by manipulating working memory constraints should be considered.

4.4 Future Direction

Further investigation into listening comprehension and expository text is required because of the importance to academic achievement. As Youse & Coelho (2005) stated there is a need for more research into these specific genres. Studies with larger samples of participants with TBI would give better indication of how working memory and listening comprehension in different genres affect this population.

Comprehension of passive versus active sentences should continue to be explored with more control on sentence type e.g. complex passives. Increasing the complexity of the passive sentences would give a clearer picture of where a breakdown in working memory occurs (Montgomery et al., 2008). Language measures of listening comprehension beyond simple syntax are needed as complex syntactic structure is more likely to show breakdowns in working memory.

Other working memory constraints/facilitators should be manipulated and the effects studied. Familiarity, reducing complexity and storage load has been shown to be a facilitator of comprehension. These facilitators provide a clear way to examine the demands placed on working memory.

Summary

Adolescents with TBI were found to perform poorly on working memory and language measures when compared to typically developing peers. The TBI group also performed more poorly on the listening comprehension task than the control group. This study also found that working memory is correlated with overall listening ability for the two groups. The results of this study did not support the hypothesis that the TBI group would show reduced performance on the listening comprehension task when working memory constraints were increased. Further research comprised of different text genres is needed to gain a clear picture of how working memory is related to listening comprehension in the adolescent TBI population. This current study presents initial findings and is a basis for ongoing research into this area of adolescent TBI and listening comprehension.

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APPENDIX A

INFORMATION SHEET

Project title: Working Memory Constraints on Listening Comprehension in Adolescents with Traumatic Brain Injury

You are invited to take part in a research project looking at the ability of teenagers with traumatic brain injuries (TBI) to understand spoken language. Please take the time to read this information sheet thoroughly, or ask the researcher to explain it to you, to see if you would like to take part or you can choose not to take part.

What is the study about?

When a child has a severe head injury (TBI), they are at risk of experiencing significant language difficulties. The difficulties show up as the child ages. Therefore, different issues arise at different times in life. This study focuses on one area of concern for teenagers with head injuries; listening comprehension.

We want to:

1. Determine the effects of working memory constraints on listening comprehension for this population.
2. Compare the results to two groups without Traumatic Brain Injury: one group of normal developing age-matched peers and one group of normal developing language age-matched children.

Within this project, we would like to gather information by assessing three groups of students' understanding of spoken language. We are inviting:

1. Teenagers with TBI
2. Normally developing teenagers without TBI but with the same age as the TBI group
3. Normally developing children without TBI but with the same reading level as the TBI group

Assessment will occur at school, home or at the University of Canterbury Speech and Hearing Clinic. The information gathered from this research will support others to create ways to improve the experience of school for adolescents with TBI.

Who is carrying out the study?

Ruth Ramsay is doing this study as part of her Master's Degree (a University course) under the supervision of Dr. Catherine Moran, Dr. Megan McAuliffe and Dr. Dean Sutherland. We are based at the Department of Communication Disorders, at the University of Canterbury.

What does this study involve?

If you choose to take part, Ruth Ramsay, will visit you at school or your home (whichever you prefer) on a number of occasions to:

- ❖ Explain the research project and ask you to sign your name to give your consent to take part (15 -30 minutes).
- ❖ Tests: Ruth will go through some assessments with you so she can gather some information about your language and memory skills. If you would like Ruth to explain these tests to you in more detail, she will be happy to do so. The tests will take 2 to 3 sessions, approximately 2.5 to 3 hours, to complete.
- ❖ Ruth will look at the results of the assessments.
- ❖ Ruth will either present or send to you a report about her what she found out.

Please note, Ruth will **record all the sessions**, using a digital video recorder and in certain sections, an audio tape recorder as well. This is so that she can make sure she has heard and understood what was said correctly. You may watch the video recordings or read any of the notes Ruth takes and delete any or all materials you do not wish to included in the study. All information, including recordings and tests results, will be stored in a locked cabinet to which only Ruth has access.

Ruth will give you breaks during the sessions so you do not become tired. If you do become tired, you can ask Ruth for a break. You can then decide whether you want to keep going or stop.

Ruth will ask your permission (consent) before coming to see you. It is okay to say 'no'. This will not affect your relationship with anyone at the University of Canterbury or any other services you may receive now or in the future. Ruth will also ask the school's permission to visit the school.

How much time will the study take?

The assessments will take 2 to 3 hours over two or three sessions. You can take a break whenever you need to and we will do it in sections on different days. A family member, carer or a friend is welcome to join you.

Can I withdraw from the study?

Taking part in the study is voluntary, your choice. If you choose to participate, you can still stop taking part at any time. Taking part in the study or not taking part will not affect your relationship with the University of Canterbury or any other services you access either now or in the future.

Will anyone else know the results?

We hope that taking part in this study will be enjoyable. By giving your time, you may be able to help people to find better ways of helping teenagers with traumatic brain injuries succeed at school. The results of this project may be published, but you may be assured that any information you have given will be kept completely confidential and nameless. For example, instead of using your name, you may be participant number two'. All the information Ruth gathers will be kept in a safe (locked) place. The identity of participants will not be made public without their consent. The data from test results may also be used in future research projects but again, the identity of the participants will be confidential.

Can I tell other people about the study?

Yes, you can tell anyone about the study, including other young people who might be interested in taking part.

What if I need to know more?

Thank you for taking the time to read this information. We look forward to hearing from you. If you would like to participate or receive further information, please fill in the contact details below by *(insert date)* and return either to the school or **contact Ruth Ramsay directly on (03) 364 2987 (Ext. 7166) or send an email to:**

ruth.ramsay@canterbury.ac.nz.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee

Anyone with concerns or complaints about the conduct of a research study can contact the Human Ethics Committee at the University of Canterbury. Email human-ethics@canterbury.ac.nz

Research team:

Ruth Ramsay
Master's of Speech-Language Therapy Student
Department of Communication Disorders, University of Canterbury
Phone: 64 (03) 364-2987
Ext: 7166 (Office)
Mobile: 021 112 1947
ruth.ramsay@canterbury.ac.nz

Dr. Catherine Moran,
Head of Department / Senior Lecturer
Department of Communication Disorders, University of Canterbury
Phone: 64 (03) 364-2401
Ext: 6401 (Office) or 7082 (Lab)
catherine.moran@canterbury.ac.nz

Dr. Megan McAuliffe
Senior Lecturer, Department of Communication Disorders, University of Canterbury

Phone: 64 (03) 364-2987
Ext: 7075 (Office) or 7205 (Lab)
megan.mcauliffe@canterbury.ac.nz

✂-----Return to school or contact Ruth Ramsay directly on the number above-----

Name:

Age:

Address:

Telephone number:

- Home
- Mobile

Email:

Please choose one of the following:

Yes I would like to take part.

Yes I would like to receive further information before deciding whether to take part. Please phone / email / arrange a visit with me (**circle which one you prefer**).

No I would not like to take part.

Any other comments/questions:

CONSENT FORM
Parents / Guardians

Project Name: Working Memory Constraints on Listening Comprehension in Adolescents with Traumatic Brain Injury

Principal Investigator:

Ruth Ramsay, Master's student, Communication Disorders Department, University of Canterbury.

Associate Investigators:

- Dr. Catherine Moran, Head of Department, Communication Disorders Department, University of Canterbury.
- Dr. Megan McAuliffe, Senior Lecturer, Communication Disorders Department, University of Canterbury.

Consent

- I have read and I understand the information sheet dated 24th of June, 2008, for participants taking part in the study designed to understand working memory constraints on listening comprehension.
- I have had the chance to talk about this study with the researcher/s. I am happy with the answers I have been given.
- I understand that my son or daughter taking part in this study is confidential (private) and that no material which could identify him or her will be used in any reports on this study.
- I have had time to think about whether I would like my son/daughter to take part.
- I understand that taking part in this study is voluntary (my son or daughter's choice) and that he or she may withdraw from the study at any time. This includes withdrawing any information he or she has provided. Taking part in the study or not taking part will not affect his/her relationship with the University of Canterbury or any other services he/she accesses either now or in the future.
- I agree to digital recordings/video being made. These will be to make sure Ruth writes down correctly what she sees and hears. Recordings will be kept in locked storage, such as a filing cabinet
- I agree to the release of information about my son or daughter's reading level by their school. I understand that this information will be kept confidential.
- I agree to digital recordings/ video being used for clinical training purposes at the University of Canterbury only.
YES / NO
- I wish to receive a copy of the results
YES / NO
- I consent to the results of this study being made available for future studies if required.
YES / NO
- I agree to publication of the results of the project with the understanding that my son's/daughter's identity remains nameless.

I understand that the project has been reviewed and approved* by the University of Canterbury Human Ethics committee.

***Anyone with concerns or complaints about the conduct of a research study can contact the Human Ethics Committee at the University of Canterbury.**

Email: human-ethics@canterbury.ac.nz

I hereby give my consent for my son/daughter (insert name)..... to take part in this study.

Name (Parent/Guardian): _____ **Date:** _____

Project explained by: _____

Project role: _____

Any other comments:

CONSENT FORM
Participant

Project Name: Working Memory Constraints on Listening Comprehension in Adolescents with Traumatic Brain Injury

Principal Investigator:

Ruth Ramsay, Master's student, Communication Disorders Department, University of Canterbury.

Associate Investigators:

- Dr. Catherine Moran, Head of Department, Communication Disorders Department, University of Canterbury.
- Dr. Megan McAuliffe, Senior Lecturer, Communication Disorders Department, University of Canterbury.

Consent

- I have read and I understand the information sheet dated 24th of June, 2008, for participants taking part in the study designed to understand working memory constraints on listening comprehension.
- I have had the chance to talk about this study with the researcher/s. I am happy with the answers I have been given.
- I understand that taking part in this study is confidential (private) and that no material which could identify me will be used in any reports on this study.
- I have had time to think about whether I would like to take part.
- I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time. This includes withdrawing any information I have provided. Taking part in the study or not taking part will not affect my relationship with the University of Canterbury or any other services I access either now or in the future.
- I agree to digital recordings/video being made. These will be to make sure Ruth writes down correctly what she sees and hears. Recordings will be kept in locked storage, such as a filing cabinet
- I agree to the release of information about my reading level by my school. I understand that this information will be kept confidential.
- I agree to digital recordings/ video being used for clinical training purposes at the University of Canterbury only.
YES / NO
- I wish to receive a copy of the results
YES / NO
- I consent to the results of this study being made available for future studies if required.
YES / NO
- I agree to publication of the results of the project with the understanding that my identity remains nameless.

I understand that the project has been reviewed and approved* by the University of Canterbury Human Ethics committee.

***Anyone with concerns or complaints about the conduct of a research study can contact the Human Ethics Committee at the University of Canterbury.**

Email: human-ethics@canterbury.ac.nz

I hereby agree to take part in this study.

Name: _____ **Date:** _____

Project explained by: _____

Project role: _____

Any other comments:

APPENDIX B

Experimental Passages

Paragraph 1a

Judo is a Japanese martial art that combines maximum efficiency with minimal effort. The opponent's strength is used to overcome the opponent. The Judo expert needs both skills of standing and ground combat. Another martial art helped to develop Judo. The first school of Judo opened in 1882. Today Judo ranks as an Olympic sport. Now, athletes all over the world play it.

Off-line Comprehension Questions

1. What is the name of this martial art?
2. What does judo use to overcome the opponent?
3. Who needs both standing and ground combat skills?
4. What was Judo developed from?
5. What opened in 1882?
6. What is Judo now ranked as?
7. Who plays judo today?

Paragraph 1b with increased constraints

Maximum efficiency with minimal effort are combined by the Japanese martial art of Judo. Judo overcomes the opponent by using the opponent's strength. Standing and ground combat are both skills are needed by the Judo expert. Judo was developed by another martial art. In 1882 the first school of judo was opened. The Olympics has now ranked Judo as an Olympic sport. Judo is now played by athletes all over the world.

Off-line Comprehension Questions

1. What is the name of this martial art?
2. What does judo use to overcome the opponent?
3. Who needs both standing and ground combat skills?
4. What was Judo developed from?
5. What opened in 1882?
6. What is Judo now ranked as?
7. Who plays judo today?

Paragraph 2a

A team sport example is Ice Hockey. Ice Hockey players play the game at a fast pace. Both men and women play Ice Hockey. At a very young age children can learn to play Ice Hockey. In Canada and Russia, Ice Hockey started as a popular sport because it is cold enough in winter to make outdoor ice rinks. Ice Hockey is Canada's official national winter sport. Indoor ice rinks mean it is now possible to play Ice Hockey all year round

Off-line Comprehension Questions

1. What kind of sport is Ice Hockey?
2. What pace is Ice Hockey played at?
3. Who can play Ice Hockey?
4. When can children begin to learn this sport?
5. What countries is Ice Hockey popular in?
6. Ice Hockey is the official national winter sport of which country?
7. Where can Ice Hockey be played all year round?

Paragraph 2b with increased constraints

Ice Hockey is an example of a sport played by a team.

The game is played at a fast pace by the Ice Hockey players.

Ice Hockey can be played by both men and women.

Playing Ice Hockey can be learned by children at a very young age.

Because it is cold enough in winter to make outdoor ice rinks, Ice Hockey started as a popular sport in Canada and Russia.

Ice Hockey is the official national winter sport of Canada.

Ice Hockey can now be played all year round on indoor ice rinks.

Off-line Comprehension Questions

1. What kind of sport is Ice Hockey?
2. What pace is Ice Hockey played at?
3. Who can play Ice Hockey?
4. When can children begin to learn this sport?
5. What countries is Ice Hockey popular in?
6. Ice Hockey is the official national winter sport of which country?
7. Where can Ice Hockey be played all year round?

Paragraph 3a

Sharks are a type of fish that have skeletons made of cartilage.

Gill slits make it possible for sharks to breathe under water.

New sets of teeth replace lost teeth for the shark.

The Whale Shark feeds on tiny plankton but is the largest at 12 meters long.

Japan and Australia eat shark.

Fish and chip shops in Australia serve shark.

'Flake' is the name for shark meat at fish and chip shops.

Off-line Comprehension Questions

1. What type of animal is a shark?
2. How do sharks breathe?
3. Why are shark's teeth special?
4. Which shark eats tiny plankton?
5. Who eats shark?
6. Who serves shark in Australia?
7. What is shark meat called in fish and chip shops?

Paragraph 3b with increased constraints

With a skeleton made of cartilage, a shark is a type of fish.

Under water, sharks breathe by using their gill slits.
When a shark loses teeth they are replaced by a new set.
Tiny plankton are eaten by the largest, 12 meters long, Whale Shark.
Shark is eaten by Japan and Australia.
Shark is served in Australia by fish and chips shops.
At fish and chip shops, shark meat is sold by the name 'Flake'.

Off-line Comprehension Questions

1. What type of animal is a shark?
2. How do sharks breathe?
3. Why are shark's teeth special?
4. Which shark eats tiny plankton?
5. Who eats shark?
6. Who serves shark in Australia?
7. What is shark meat called in fish and chip shops?

Paragraph 4a

Meteorology studies weather.
Meteorology studies common weather such as rain, snow and wind.
Natural disasters such as [tornadoes](#) and [hurricanes](#) are studied too.
Changes in the weather in one place on earth affect the weather in other places.
These changes make it hard to predict what the weather will do.
The hot sun and cool oceans can also affect the weather.
Two weeks ahead is the limit for correct weather forecasts.

Off-line Comprehension Questions

1. What is the study of weather called?
2. What kinds of common weather does Meteorology study?
3. What types of weather are tornadoes and hurricanes?
4. How is weather affected?
5. Why is weather hard to predict?
6. What else affects the weather?
7. How far ahead are weather forecasts correct?

Paragraph 4b with increased constraints

Weather is studied by Meteorology.
Common weather such as rain, snow and wind are studied by Meteorology.
Also studied are [tornadoes](#) and [hurricanes](#) which are natural disasters.
One place's weather on the earth is affected by changes in other places.
What the weather will do is hard to predict because of the changes.
The weather is also affected by hot sun and cool oceans.
Weather forecasts are not correct more than two weeks ahead.

Off-line Comprehension Questions

1. What is the study of weather called?
2. What kinds of common weather does Meteorology study?
3. What types of weather are tornadoes and hurricanes?
4. How is weather affected?
5. Why is weather hard to predict?

6. What else affects the weather?
7. How far ahead are weather forecasts correct?

Paragraph 5a

The English and French governments made the Concorde aircraft.

This [supersonic](#) airplane's 27 years of flying started in 1976.

Concorde flew passengers from London to New York in half the time of regular planes.

The manufacturers only made 20 Concordes.

The planes were very expensive to make and meant that the companies involved lost a lot of money.

Concorde only had one crash in its history.

Its design and speed made Concorde famous all over the world.

Off-line Comprehension Questions

1. Who made the Concorde?
2. What kind of plane is the Concorde?
3. Where did Concorde fly to?
4. How many Concordes were made?
5. Why was a lot of money lost by the companies?
6. How many crashes did Concorde have?
7. Why is Concorde famous?

Paragraph 5b with increased constraints

The Concorde aircraft was made by the English and French governments.

In 1976, 27 years of flying had been completed by this supersonic airplane.

In half the time of regular planes, passengers were flown from London to New York by Concorde.

Only 20 Concordes were ever made by manufacturers.

A lot of money was lost by the companies because the planes were very expensive to make.

Only one crash was recorded in Concorde's history.

All over the world, Concorde was made famous by its design and speed.

Off-line Comprehension Questions

8. Who made the Concorde?
9. What kind of plane is the Concorde?
10. Where did Concorde fly to?
11. How many Concordes were made?
12. Why was a lot of money lost by the companies?
13. How many crashes did Concorde have?
14. Why is Concorde famous?

Paragraph 6a

Anyone can enjoy fishing for sport or recreation.

On a boat or off the shore, fishing can be fun.

There are laws that limit the type of fish caught.

Recreational fishermen are not allowed to use nets.

A rod with a hook is often used to catch fish.

'Catch and release' is the term used when a fisherman catches a fish and then lets it go.

Big-game fishermen catch large fish such as sharks and marlin.

Off-line Comprehension Questions

1. Who can enjoy fishing?
2. Where can people fish from?
3. What limits the types of fish that can be caught?
4. Who is not allowed to use nets?
5. What is often used to catch fish?
6. What is the term used when a fish is caught and then let go?
7. Who catches sharks and marlin?

Paragraph 6b with increased constraints

For sport or recreation, fishing can be enjoyed by anyone.

Fishing can be fun off the shore or by boat.

The type of fish caught is limited by laws.

Nets can not be used by recreational fishermen.

Catching fish is often done by using a rod and a hook.

The term used by a fisherman when they catch a fish and then let it go is 'catch and release'.

Catching sharks and marlin is done by big-game fishermen.

Off-line Comprehension Questions

1. Who can enjoy fishing?
2. Where can people fish from?
3. What limits the types of fish that can be caught?
4. Who is not allowed to use nets?
5. What is often used to catch fish?
6. What is the term used when a fish is caught and then let go?
7. Who catches sharks and marlin?

Paragraph 7a

Americans started the Hip Hop culture in the 1970's.

Rap with its rhythmic vocal style is part of Hip Hop.

Backing beats help the rapper to keep rhythm.

DJs create these beats for the rapper.

Other songs are used to make up the DJs music.

Live bands are also used to play music for the rapper to speak to.

Using poetry creates lyrics for the rapper to say.

Off-line Comprehension Questions

1. Who started Hip Hop?
2. What rhythmic vocal style is part of Hip Hop?
3. What helps the rapper keep rhythm?
4. Who creates beats for the rapper?
5. What does the DJ use to make music?
6. Who else might play for the rapper?
7. How are lyrics created?

Paragraph 7b with increased constraints

Hip Hop music started in the 1970's by Americans.

Part of Hip Hop is a rhythmic vocal style called Rap.
The rapper keeps rhythm by using backing beats.
The rapper uses beats created by the DJ.
The DJ makes up music by using other songs.
Music for the rapper to speak to is sometimes played by live bands.
Lyrics for the rapper to say are created by using poetry.

Off-line Comprehension Questions

1. Who started Hip Hop?
2. What rhythmic vocal style is part of Hip Hop?
3. What helps the rapper keep rhythm?
4. Who creates beats for the rapper?
5. What does the DJ use to make music?
6. Who else might play for the rapper?
7. How are lyrics created?

Paragraph 8a

Mammals, as a group, include bats.
Flapping their forelimbs which are wings, bats can fly.
Membrane stretches between the bones of the forelimb to make the wing.
Pollinating flowers is one of the important jobs bats perform.
Insects are food for 70% of bats.
When the sun is going down, bats come out to eat.
Most places on earth have bats.

Off-line Comprehension Questions

1. What kind of animal is a bat?
2. Why can bats fly?
3. How is the wing made?
4. What job do bats do?
5. What do bats eat?
6. What time of day do bats eat?
7. Where do bats live?

Paragraph 8b with increased constraints

Bats are a type of mammal.
Bats fly by flapping their forelimbs, which are wings.
The wing is made by membrane stretching between the bones of the forelimb.
Bats perform an important job by pollinating flowers.
70% of bats eat insects.
Bats come out to eat when the sun is going down.
Bats are found in most places on earth.

Off-line Comprehension Questions

1. What kind of animal is a bat?
2. Why can bats fly?
3. How is the wing made?
4. What job do bats do?
5. What do bats eat?

6. What time of day do bats eat?
7. Where do bats live?

Paragraph 9a

Mountain bikers use specially made bicycles to ride off-road.
Suspension is built into these bicycles so that the bikers can deal with rough terrain.
Cross country is a type of mountain biking.
Safety is a very important part of this individual sport.
The rider has to be able to repair their broken bikes and flat tyres.
On longer rides groups bike together to provide support.
Different levels of difficulty mean that anyone can enjoy mountain biking.

Off-line Comprehension Questions

1. Who rides off-road?
2. What helps the bicycles deal with rough terrain?
3. What is one type of mountain biking?
4. What is an important part of this sport?
5. Who fixes bikes during rides?
6. When do groups bike together?
7. Why can anyone enjoy mountain biking?

Paragraph 9b with increased constraints

Riding off-road with specially made bicycles is done by Mountain bikers.
Rough terrain is dealt with by building in suspension.
One type of mountain biking is cross country.
One important part of this individual sport is safety.
Broken bikes and flat tyres have to be repaired by the rider.
Support is provided by groups biking together on longer rides.
Anyone can enjoy mountain biking because it has different levels of difficulty.

Off-line Comprehension Questions

1. Who rides off-road?
2. What helps the bicycles deal with rough terrain?
3. What is one type of mountain biking?
4. What is an important part of this sport?
5. Who fixes bikes during rides?
6. When do groups bike together?
7. Why can anyone enjoy mountain biking?

Paragraph 10a

Combining music with text enables Opera to tell a story on stage.
Musicians and singers perform this dramatic art form.
An orchestra can be used to provide the music.
An opera house is where most operas are held.
Italy started this form of theatre.
Comic opera is one type.
Radio also has had operas written for it.

Off-line Comprehension Questions

1. What does opera combine text with?
2. Who performs opera?
3. Who provides the music for opera?
4. Where is opera performed?
5. Where did opera start?
6. What is one type of opera?
7. Where else are operas heard?

Paragraph 10b with increased constraints

Opera tells a story on stage by combining text with music.
This dramatic art form is performed by musicians and singers.
The music is often provided by an orchestra.
Operas are usually held in an opera house.
This form of theatre was started by Italy.
One type is comic opera.
Operas have also been written for radio.

Off-line Comprehension Questions

1. What does opera combine text with?
2. Who performs opera?
3. Who provides the music for opera?
4. Where is opera performed?
5. Where did opera start?
6. What is one type of opera?
7. Where else are operas heard?

Fillers

F 1

Mountaineering is a sport that involves climbing mountains.
Climbers compete with others by trying to reach the top first.
Routes up the mountain can be over rock, snow and ice.
Snow-craft is one specialty of mountaineering.
All types of mountaineering require safety first.
Good equipment is used by the mountaineer to keep them safe.
Athletic ability is needed to endure the hard conditions.

Off-line Comprehension Questions

1 point given for each correct answer

1. What is the sport of climbing mountains called?
2. How do climbers compete?
3. What types of ground can be on the route up?
4. What is one speciality of mountaineering?
5. What do all types of mountaineering need to think of first?
6. What is used to keep the climber safe?
7. What is needed to endure this sport?

F 2

Praying Mantis is a type of insect.
The bright green body of this insect helps it to hide on plants.
They prey on other insects by waiting for them to come near.
This insect has long front legs that it grabs and holds its food with.
The Praying Mantis hunts by using very good vision.
Lizards and frogs have been eaten by large species of Praying Mantis.
The head of this insect can rotate almost 300 degrees.

Off-line Comprehension Questions

1 point given for each correct answer

1. What type of animal is a Praying Mantis?
2. What does the bright green colour help the Praying Mantis to do?
3. How do they catch other insects?
4. How does it hold its food?
5. What helps the Praying Mantis hunt?
6. What have large species of Praying Mantis eaten?
7. How far can the head rotate?

F 3

A loom is a machine used for weaving and making material.
A hand-held loom is the smallest.
Huge automatic looms also exist, in factories.
Looms are operated by trained people.
Looms were first used by ancient people thousands of years ago.
The thread is held tight by the loom while other thread is woven in.
Looms are used by many different cultures to make material.

Off-line Comprehension Questions

1 point given for each correct answer

1. What is the name of this machine?
2. What is the smallest loom?
3. Where are huge looms found?
4. What type of person operates looms?
5. When were looms first used?
6. What is held tight?
7. What do people use looms for?

F 4

The combination of a metal blade and machine makes a circular saw.
The machine makes the metal blade spin.
This tool is used to cut wood by carpenters.
Different blades can cut stone, metal or plastic.

Today, circular saws are powered by electricity.
Some saws can be hand-held for use on small projects.
Large saws can be used to cut huge trees at saw mills.

Off-line Comprehension Questions

1 point given for each correct answer

1. What is the machine combined with to make a circular saw?
2. What does the machine do?
3. Who uses this type of tool?
4. What is needed to cut stone, metal or plastic?
5. What powers circular saws?
6. What are hand-held saws used for?
7. Where are huge saws found?

F 5

A Blimp is a free flying aircraft.
The passenger car underneath the body is the only solid part.
The propeller is used to steer the Blimp.
Gases fill the giant airbag of the aircraft and create lift.
Helium is the most common gas used.
Blimps are easy to transport because they can be deflated.
Modern Blimps are heavier and lift off by using more engine power.

Off-line Comprehension Questions

1 point given for each correct answer

1. What is the name of this aircraft?
2. What is the only solid part?
3. What steers the Blimp?
4. What fills the hull of the aircraft?
5. Why are Blimps easy to transport?
6. What gas is commonly used?
7. What do modern Blimps need to lift off?

APPENDIX C

Marking Guide

Set 1

Paragraph

Mammals, as a group, include bats.

Flapping their forelimbs which are wings, bats can fly.

Membrane stretches between the bones of the forelimb to make the wing.

Pollinating flowers is one of the important jobs bats perform.

Insects are food for 70% of bats.

When the sun is going down, bats come out to eat.

Most places on earth have bats.

Comprehension Questions

1. What kind of animal is a bat? **Mammal**
2. Why can bats fly? **They have wings/ Flap their forelimbs/combo**
3. How is the wing made? **Membrane/Membrane stretching between the forelimbs**
4. What job do bats do? **Pollinate/ Pollinate flowers**
5. What do bats eat? **Insects/Bugs**
6. What time of day do bats eat? **When the sun is going down/ Dusk/ Evening/At night**
7. Where do bats live? **Most places on earth**

Paragraph

The Concorde aircraft was made by the English and French governments.

In 1976, 27 years of flying had been completed by this supersonic airplane.

In half the time of regular planes, passengers were flown from London to New York by Concorde.

Only 20 Concorde were ever made by manufacturers.

A lot of money was lost by the companies because the planes were very expensive to make.

Only one crash was recorded in Concorde's history.

All over the world, Concorde was made famous by its design and speed.

Comprehension Questions

15. Who made the Concorde? **English and French**
16. What kind of plane is the Concorde? **Supersonic**
17. Where did Concorde fly to? **London to New York/Europe to America**
18. How many Concorde were made? **20**

19. Why was a lot of money lost by the companies? **The planes were expensive/ Cost a lot (to make)**
20. How many crashes did Concorde have? **1**
21. Why is Concorde famous? **It's design and speed/ The way it was made and how fast it was/Fastest plane or jet**

Paragraph

Judo is a Japanese martial art that combines maximum efficiency with minimal effort. The opponent's strength is used to overcome the opponent. The Judo expert needs both skills of standing and ground combat. Another martial art helped to develop Judo. The first school of Judo opened in 1882. Today Judo ranks as an Olympic sport. Now, athletes all over the world play it.

Comprehension Questions

8. What is the name of this martial art? **Judo**
9. What does judo use to overcome the opponent? **The opponent's strength**
10. Who needs both standing and ground combat skills? **The Judo expert/ athlete/People that do Judo**
11. What was Judo developed from? **Another martial art/Japanese martial art**
12. What opened in 1882? **A judo school/academy/dojo/Judo training place**
13. What is Judo now ranked as? **Olympic sport**
14. Who plays judo today? **Athletes everywhere/People all over the world**

Paragraph

Hip Hop music started in the 1970's by Americans. Part of Hip Hop is a rhythmic vocal style called Rap. The rapper keeps rhythm by using backing beats. The rapper uses beats created by the DJ. The DJ makes up music by using other songs. Music for the rapper to speak to is sometimes played by live bands. Lyrics for the rapper to say are created by using poetry.

Comprehension Questions

1. Who started Hip Hop? **Americans**
2. What rhythmic vocal style is part of Hip Hop? **Rap**

3. What helps the rapper keep rhythm? **Backing beats/Beats/Music**
4. Who creates beats for the rapper? **DJ**
5. What does the DJ use to make music? **Other songs/Other music/CDs**
6. Who else might play for the rapper? **Live bands/Bands**
7. How are lyrics created? **Poetry/Rhymes**

Paragraph

With a skeleton made of cartilage, a shark is a type of fish.

Under water, sharks breathe by using their gill slits.

When a shark loses teeth they are replaced by a new set.

Tiny plankton are eaten by the largest, 12 meters long, Whale Shark.

Shark is eaten by Japan and Australia.

Shark is served in Australia by fish and chips shops.

At fish and chip shops, shark meat is sold by the name 'Flake'.

Comprehension Questions

1. What type of animal is a shark? **Fish**
2. How do sharks breathe? **Through their gill slits/Gills**
3. Why are shark's teeth special? **They grow a new set when one set is lost/ They get replaced**
4. Which shark eats tiny plankton? **Whale Shark**
5. Who eats shark? **Japan and Australia/ Japanese and Australians**
6. Who serves shark in Australia? **Fish and chips shops**
7. What is shark meat called in fish and chip shops? **Flake**

Set2

Fillers – do not mark

Mountaineering, PMantis,Loom,CSaw,Blimp

Set 3

Paragraph

Weather is studied by Meteorology.

Common weather such as rain, snow and wind are studied by Meteorology.

Also studied are [tornadoes](#) and [hurricanes](#) which are natural disasters.

One place's weather on the earth is affected by changes in other places.

What the weather will do is hard to predict because of the changes.

The weather is also affected by hot sun and cool oceans.

Weather forecasts are not correct more than two weeks ahead.

Comprehension Questions

1. What is the study of weather called? **Meteorology**
2. What kinds of common weather does Meteorology study? **Rain, snow and wind (in any order)**
3. What types of weather are tornadoes and hurricanes? **Natural disasters/ Catastrophes/ Extreme weather**
4. How is weather affected? **By changes in weather in other places on earth**
5. Why is weather hard to predict? **Because of the changes/ It changes all the time**
6. What else affects the weather? **Hot sun, Cool oceans (sea)**
7. How far ahead are weather forecasts correct? **2 weeks**

Paragraph

A team sport example is Ice Hockey.

Ice Hockey players play the game at a fast pace.

Both men and women play Ice Hockey.

At a very young age children can learn to play Ice Hockey.

In Canada and Russia, Ice Hockey started as a popular sport because it is cold enough in winter to make outdoor ice rinks.

Ice Hockey is Canada's official national winter sport.

Indoor ice rinks mean it is now possible to play Ice Hockey all year round

Comprehension Questions

1. What kind of sport is Ice Hockey? **Team**
2. What pace is Ice Hockey played at? **Fast/Quick**
3. Who can play Ice Hockey? **Anyone/Men and women**

4. When can children begin to learn this sport? **At a young age/ When they are**

little/Anytime

5. What countries is Ice Hockey popular in? **Canada and Russia (or Europe)**

6. Ice Hockey is the official national winter sport of which country? **Canada**

7. Where can Ice Hockey be played all year round? **Indoor ice rinks/Inside**

rinks/Indoors/Inside

Paragraph

Anyone can enjoy fishing for sport or recreation.

On a boat or off the shore, fishing can be fun.

There are laws that limit the type of fish caught.

Recreational fishermen are not allowed to use nets.

A rod with a hook is often used to catch fish.

'Catch and release' is the term used when a fisherman catches a fish and then lets it go.

Big-game fishermen catch large fish such as sharks and marlin.

Comprehension Questions

1. Who can enjoy fishing? **Anyone/Everyone/People who want to fish**

2. Where can people fish from? **Shore and boats / Off shore (meaning off the shore)**

and off boats

3. What limits the types of fish that can be caught?

Laws/Rules/Regulations/Government

4. Who is not allowed to use nets? **Recreational fishermen (Recreational fishers also accepted)**

5. What is often used to catch fish? **Rod and hook/Fishing rods/Rods**

6. What is the term used when a fish is caught and then let go? **Catch and release**

7. Who catches sharks and marlin? **Big game fishermen (Recreational fishers also**

accepted)

Paragraph

Opera tells a story on stage by combining text with music.

This dramatic art form is performed by musicians and singers.

The music is often provided by an orchestra.

Operas are usually held in an opera house.

This form of theatre was started by Italy.

One type is comic opera.
Operas have also been written for radio.

Comprehension Questions

1. What does opera combine text with? **Music/Songs**
2. Who performs opera? **Musicians and singers**
3. Who provides the music for opera? **Orchestra(s)**
4. Where is opera performed? **An opera house**
5. Where did opera start? **Italy/Europe**
6. What is one type of opera? **Comic**
7. Where else are operas heard? **Radio(s)**

Paragraph

Mountain bikers use specially made bicycles to ride off-road.
Suspension is built into these bicycles so that the bikers can deal with rough terrain.
Cross country is a type of mountain biking.
Safety is a very important part of this individual sport.
The rider has to be able to repair their broken bikes and flat tyres.
On longer rides groups bike together to provide support.
Different levels of difficulty mean that anyone can enjoy mountain biking.

Comprehension Questions

1. Who rides off-road? **Mountain bikers**
2. What helps the bicycles deal with rough terrain? **Suspension/Shocks**
3. What is one type of mountain biking? **Cross country**
4. What is an important part of this sport? **Safety/Examples of safety accepted as well
i.e. Wearing a helmet**
5. Who fixes bikes during rides? **The rider/ The mountain biker themselves**
6. When do groups bike together? **Longer rides/ Long distance**
7. Why can anyone enjoy mountain biking? **Different levels**

Set 4

Paragraph

Maximum efficiency with minimal effort are combined by the Japanese martial art of Judo.
Judo overcomes the opponent by using the opponent's strength.
Standing and ground combat are both skills are needed by the Judo expert.

Judo was developed by another martial art.
In 1882 the first school of judo was opened.
The Olympics has now ranked Judo as an Olympic sport.
Judo is now played by athletes all over the world.

Comprehension Questions

1. What is the name of this martial art? **Judo**
2. What does judo use to overcome the opponent? **The opponent's strength**
3. Who needs both standing and ground combat skills? **The Judo expert/athlete/People that do Judo**
4. What was Judo developed from? **Another martial art/ Japanese martial art**
5. What opened in 1882? **A judo school/academy/dojo**
6. What is Judo now ranked as? **Olympic sport**
7. Who plays judo today? **Athletes everywhere/People all over the world**

Paragraph

Americans started the Hip Hop culture in the 1970's.
Rap with its rhythmic vocal style is part of Hip Hop.
Backing beats help the rapper to keep rhythm.
DJs create these beats for the rapper.
Other songs are used to make up the DJs music.
Live bands are also used to play music for the rapper to speak to.
Using poetry creates lyrics for the rapper to say.

Comprehension Questions

1. Who started Hip Hop? **Americans**
2. What rhythmic vocal style is part of Hip Hop? **Rap**
3. What helps the rapper keep rhythm? **Backing beats/BeatsMusic**
4. Who creates beats for the rapper? **DJ**
5. What does the DJ use to make music? **Other songs/Other music**
6. Who else might play for the rapper? **Live bands/Bands**
7. How are lyrics created? **Poetry/Rhymes**

Paragraph

Bats are a type of mammal.

Bats fly by flapping their forelimbs, which are wings.
The wing is made by membrane stretching between the bones of the forelimb.
Bats perform an important job by pollinating flowers.
70% of bats eat insects.
Bats come out to eat when the sun is going down.
Bats are found in most places on earth.

Comprehension Questions

1. What kind of animal is a bat? **Mammal**
2. Why can bats fly? **They have wings/ Flap their forelimbs/combo**
3. How is the wing made? **Membrane/Membrane stretching between the forelimbs**
4. What job do bats do? **Pollinate/ Pollinate flowers**
5. What do bats eat? **Insects/Bugs**
6. What time of day do bats eat? **When the sun is going down/ Dusk/Evening/At night**
7. Where do bats live? **Most places on earth**

Paragraph

Ice Hockey is an example of a sport played by a team.
The game is played at a fast pace by the Ice Hockey players.
Ice Hockey can be played by both men and women.
Playing Ice Hockey can be learned by children at a very young age.
Because it is cold enough in winter to make outdoor ice rinks, Ice Hockey started as a popular sport in Canada and Russia.
Ice Hockey is the official national winter sport of Canada.
Ice Hockey can now be played all year round on indoor ice rinks.

Comprehension Questions

1. What kind of sport is Ice Hockey? **Team**
2. What pace is Ice Hockey played at? **Fast**
3. Who can play Ice Hockey? **Anyone/Men and women**
4. When can children begin to learn this sport? **At a young age/ When they are little/Anytime**
5. What countries is Ice Hockey popular in? **Canada and Russia (or Europe)**
6. Ice Hockey is the official national winter sport of which country? **Canada**
7. Where can Ice Hockey be played all year round? **Indoor ice rinks/Inside rinks/Indoors/Inside**

Paragraph

The English and French governments made the Concorde aircraft.

This supersonic airplane's 27 years of flying started in 1976.

Concorde flew passengers from London to New York in half the time of regular planes.

The manufacturers only made 20 Concorde.

The planes were very expensive to make and meant that the companies involved lost a lot of money.

Concorde only had one crash in its history.

Its design and speed made Concorde famous all over the world.

Comprehension Questions

1. Who made the Concorde? **English and French**
2. What kind of plane is the Concorde? **Supersonic**
3. Where did Concorde fly to? **London to New York/Europe to America**
4. How many Concorde were made? **20**
5. Why was a lot of money lost by the companies? **The planes were expensive/ Cost a lot (to make)/Spent it all on the planes**
6. How many crashes did Concorde have? **1**
7. Why is Concorde famous? **It's design and speed/ The way it was made and how fast it was**

Set 5

Fillers – Do not mark

Loom,Blimp,PMantis,Mountaineering,CSaw

Set 6

Paragraph

Sharks are a type of fish that have skeletons made of cartilage.

Gill slits make it possible for sharks to breathe under water.

New sets of teeth replace lost teeth for the shark.

The Whale Shark feeds on tiny plankton but is the largest at 12 meters long.

Japan and Australia eat shark.

Fish and chip shops in Australia serve shark.
'Flake' is the name for shark meat at fish and chip shops.

Comprehension Questions

1. What type of animal is a shark? **Fish**
2. How do sharks breathe? **Through their gill slits/Gills**
3. Why are shark's teeth special? **They grow a new set when one set is lost/ They get replaced**
4. Which shark eats tiny plankton? **Whale Shark/largest in the world**
5. Who eats shark? **Japan and Australia/ Japanese and Australians**
6. Who serves shark in Australia? **Fish and chips shops**
7. What is shark meat called in fish and chip shops? **Flake**

Paragraph

Meteorology studies weather.
Meteorology studies common weather such as rain, snow and wind.
Natural disasters such as [tornadoes](#) and [hurricanes](#) are studied too.
Changes in the weather in one place on earth affect the weather in other places.
These changes make it hard to predict what the weather will do.
The hot sun and cool oceans can also affect the weather.
Two weeks ahead is the limit for correct weather forecasts.

Comprehension Questions

1. What is the study of weather called? **Meteorology**
2. What kinds of common weather does Meteorology study? **Rain, snow and wind (in any order) or 2 out of 3 with others added i.e. heat etc**
3. What types of weather are tornadoes and hurricanes? **Natural disasters/ Catastrophes/ Extreme weather**
4. How is weather affected? **By changes in weather in other places on earth**
5. Why is weather hard to predict? **Because of the changes/ It changes all the time**
6. What else affects the weather? **Hot sun, Cool oceans (sea)**
7. How far ahead are weather forecasts correct? **2 weeks**

Paragraph

For sport or recreation, fishing can be enjoyed by anyone.

Fishing can be fun off the shore or by boat.
The type of fish caught is limited by laws.
Nets can not be used by recreational fishermen.
Catching fish is often done by using a rod and a hook.
The term used by a fisherman when they catch a fish and then let it go is 'catch and release'.
Catching sharks and marlin is done by big-game fishermen.

Comprehension Questions

1. Who can enjoy fishing? **Anyone/Everyone**
2. Where can people fish from? **Shore and boats / Off shore (meaning off the shore) and off boats/ Can also give names of actual places**
3. What limits the types of fish that can be caught?

Laws/Rules/Regulations/Government

4. Who is not allowed to use nets? **Recreational fishermen (Recreational fishers also accepted)**
5. What is often used to catch fish? **Rod and hook**
6. What is the term used when a fish is caught and then let go? **Catch and release**
7. Who catches sharks and marlin? **Big game fishermen (Recreational fishers also accepted)**

Paragraph

Combining music with text enables Opera to tell a story on stage.
Musicians and singers perform this dramatic art form.
An orchestra can be used to provide the music.
An opera house is where most operas are held.
Italy started this form of theatre.
Comic opera is one type.
Radio also has had operas written for it.

Comprehension Questions

1. What does opera combine text with? **Music/Songs**
2. Who performs opera? **Musicians and singers/Actors accepted**
3. Who provides the music for opera? **Orchestra(s)**
4. Where is opera performed? **An opera house**
5. Where did opera start? **Italy**

6. What is one type of opera? **Comic**

7. Where else are operas heard? **Radio(s)**

Paragraph

Riding off-road with specially made bicycles is done by Mountain bikers.

Rough terrain is dealt with by building in suspension.

One type of mountain biking is cross country.

One important part of this individual sport is safety.

Broken bikes and flat tyres have to be repaired by the rider.

Support is provided by groups biking together on longer rides.

Anyone can enjoy mountain biking because it has different levels of difficulty.

Comprehension Questions

1. Who rides off-road? **Mountain bikers**

2. What helps the bicycles deal with rough terrain? **Suspension/Shocks**

3. What is one type of mountain biking? **Cross country**

4. What is an important part of this sport? **Safety/Can give example of safety i.e. helmet**

5. Who fixes bikes during rides? **The rider/ The mountain biker themselves**

6. When do groups bike together? **Longer rides/ Long distance**

7. Why can anyone enjoy mountain biking? **Different levels**

APPENDIX D

Working Memory Span Task (from Tompkins et al., 1994)

Name: _____

Date: _____

D.O. B.: _____

Age: _____

Administration Directions – Each item is preceded by the word “Ready?”

Allow 1 second between the alert and the first stimulus

Allow a 3 second interval between each sentence

Allow 5 seconds between each set

Instructions:

“First listen to these sentences and say “True or False”

Trial: A cow gives juice.

The sky is blue.

“Now I want you to remember the last words of these sentences”

Trial: The milk is cold.

The fruit is in the bowl.

“This time, I want you to tell me whether the sentence is true or false and then, when I raise my finger, tell me the last word in the sentence. Let’s try it”

Trial: Fish can swim.

Winter is hot.

LEVEL 2 SETS – “Now you will hear two sentences

Set 1

You sit on a chair _____ (T)

Trains can fly. _____ (F)

Words Remembered:

Set 2

A table is an animal _____ (F)

Children like games _____ (T)

Words Remembered:

Set 3

Tigers live in houses _____ (F)

Milk is white _____ (T)

Words Remembered:

LEVEL 3 Sets- "Now you will hear three sentences"

Set 4

Sugar is sweet. _____ (T)
Auckland is in the South Island _____ (F)
Horses run in the sky. _____ (F)

Words Remembered:

Set 5

You can ride on a bus. _____ (T)
Cats can talk _____ (F)
Apples grow on trees _____ (T)

Words Remembered:

Set 6

Pumpkins are purple _____ (F)
Mice are smaller than lions _____ (T)
Roses have thorns. _____ (T)

Words Remembered:

LEVEL 4 SETS – "Now you will hear four sentences"

Set 7

Twelve equals one dozen. _____ (T)
Bicycles are slower than cars _____ (T)
A book can play. _____ (F)
Feathers can tickle _____ (T)

Words Remembered:

Set 8

Water is dry. _____ (F)
Cows like to eat grass _____ (T)
Ducks have webbed feet _____ (T)
Little boys wear dresses _____ (F)

Words Remembered:

Set 9

Chickens eat eggs. _____ (F)
Babies can drive _____ (F)
A clock tells time. _____ (T)
The sky is green _____ (F)

Words Remembered:

LEVEL 5 SETS –“Now you will hear 5 sentences”

Set 10

- Carrots can dance. _____ (F)
- Fish swim in water _____ (T)
- You sleep on a bed. _____ (T)
- You eat breakfast at night _____ (F)
- People have eyes _____ (T)

Words Remembered:

Set 11

- An orange is a fruit. _____ (T)
- February has 60 days _____ (F)
- A shoe has ears. _____ (F)
- You wash with soap _____ (T)
- A car can race _____ (T)

Set 12

- You keep books in ovens. _____ (F)
- Rabbits can read _____ (F)
- A lobster has a shell. _____ (T)
- Chairs can eat _____ (F)
- Dogs have four legs _____ (T)
