
Development and Piloting of the Starship Posttraumatic Amnesia Scale for Children Aged Between Four and Six Years

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The aim of this study was to develop and pilot a posttraumatic amnesia scale (PTA) scale for children aged between four and six years. The scale consists of seven orientation questions and five memory items modelled on the Westmead PTA Scale which assesses posttraumatic amnesia in children from eight years onwards and adults. The sample consisted of 45 four-year-olds, 82 five-year-olds and 49 six-year-old children from a variety of cultural and socioeconomic backgrounds. Children were recruited from hospitals, kindergartens and schools. Results were analysed across age groups using means and standard deviations. The orientation and memory items were analysed separately as well as in combination. Early analyses indicate that the majority of normal children in the four to 6 year age group can answer most of the orientation questions correctly and remember the memory stimuli from day to day. The results indicate that the Starship PTA Scale is suitable for young children aged 4 to 6 years. It is simple and quick to administer and utilises an operational definition of posttraumatic amnesia in terms of measuring continuous memory.

Posttraumatic amnesia is the duration of impaired consciousness following head trauma which includes both the period of coma and anterograde amnesia (Ponsford, Sloan & Snow, 1995). It is defined as the period from the time of brain injury to the period when the person is again able to form continuous new day-to-day memories (Kinsella et al., 1997). During PTA, people are disoriented and confused and often agitated because of their impaired capacity to store and recall ongoing events or new experiences continuously into memory (Spreen, Risser & Edgell, 1995).

Duration of PTA has been found to be related to severity of head injury and degree of long-term cognitive deficits (Spreen et al., 1995). Chadwick, Rutter, Brown, Shaffer & Traub (1981a) advised that a PTA duration of less than 24 hours resulted in children experiencing no cognitive sequelae, a

PTA duration of two weeks was associated with some degree of cognitive impairment, and a PTA duration of greater than three weeks was associated with permanent cognitive impairment. Duration of PTA has been found to be more useful in predicting residual cognitive problems or functional independence than have depth or duration of coma, and Magnetic Resonance Imaging (MRI) (Greenwood, 1997; McMillan, Jongen & Greenwood, 1996).

For many years, the typical method of assessing PTA was to utilise retrospective recall (Wilson, Teasdale, Hadley, Wiedmann & Lang, 1993). Relying on this method has been thought, by some researchers and workers in the head injury field, to produce unreliable data for a variety of possible reasons including confabulation, false memories, islands of memory and reconstruction of events. It is not unusual for people to

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confabulate or to reconstruct the events based on others' accounts of the events rather than their own recall of events (McMillan et al., 1996). However, McMillan et al. (1996) also found that retrospective measurement of PTA can be reliable and valid obtaining high correlations between prospective measurement, as assessed with the Galveston Orientation and Amnesia Test (GOAT), and retrospective measurement of PTA.

Prospective measurement of PTA duration avoids some of the criticism levelled at using retrospective methods of measuring PTA. Ewing-Cobbs, Levin, Fletcher, Miner and Eisenberg (1990) developed the Children's Orientation and Amnesia Test (COAT) to evaluate orientation and memory in children and adolescents serially during their recovery from traumatic brain injury (TBI). Included in this scale are items assessing temporal orientation, immediate, short-term and remote memory, recall of biographical information, and general orientation to person and place. The duration of PTA is defined as the number of days the COAT scores are in the impaired range (2 standard deviations below the mean). Norms are available for children aged between 3 and 15 years. Problems associated with this scale are that it does not assess ongoing or continuous memory, and that it relies on school-based normative data and, therefore, failed to acknowledge the possible confounding effects of the hospital environment.

The Westmead PTA Scale is a standardised quantitative measure developed by Shores, Marosszaky, Sandanam & Batchelor (1986) to assess duration of PTA in adults following TBI. The scale requires people to provide their age, date of birth, assesses orientation to time and place, the capacity for recall of a face and name, and the recall or recognition of three pictures they have been shown the day before. The procedure is repeated until a perfect score of 12 is obtained on three successive days. The period of PTA is said to have ended on the first of these three days.

Research has revealed that the Westmead PTA Scale has a high degree of inter-rater reliability as well as predictive and concurrent validity (Shores et al., 1986). Marosszaky et al. (1993) carried out research investigating whether the Westmead PTA Scale could be used with children. They administered the scale to hospitalised non-head-injured children between 6 and 16 years. They discovered that the majority of children over 7 years of age could answer all the orientation and memory items. Therefore, it is considered that the Westmead PTA Scale can be used validly with children aged 8 years and older.

The aim of this research was to develop a standardised measure appropriate for assessing

posttraumatic amnesia in children aged three to six years. An operational definition of PTA was used. A child is deemed to be in PTA if he/she cannot achieve a score within one standard deviation of the mean for 3 consecutive days. PTA is judged to have ended on the first of the 3 consecutive days of achieving scores within one standard deviation of the mean

Method

Piloting of the Starship PTA Scale

Construction of the Starship PTA Scale

The theory and format of the Westmead Post-traumatic Amnesia Scale (Shores, et al., 1986) was used to develop the Starship PTA Scale. As is the case with the Westmead PTA Scale, the Starship PTA Scale measures orientation to time, place and person and capacity for new learning.

The orientation questions for the Starship PTA Scale were developed through consultation with speech/language therapists, occupational therapists and neuropsychologists experienced in the paediatric neurology field. The scale includes six/seven orientation questions and five memory items (see Appendix A for a copy of the Starship PTA Scale scoring form). The scale was perused by a cultural advisor from Starship Hospital and was deemed to be appropriate in content for children from all cultures if English was their first language or if their English abilities were equivalent to the average child in their age-group.

The scale was piloted with a group of 20 hospitalised children admitted to general surgical, medical and orthopaedic wards, for reasons other than head injury and then a larger group ($n = 27$) were administered the scale to obtain norms for non head injured hospitalised children. Children were included in the study if they could converse at an age-appropriate level in English, had no history of psychiatric problems, no significant learning or academic difficulties, and no documented history of CNS dysfunction. The aim of this pilot study was to determine whether the orientation and memory items were appropriate for 3- to 6-year-old children.

Administration of the Starship PTA Scale to a Hospitalised Sample

Each morning, therapists from Children's Therapy Services, Starship Hospital, visited those newly admitted patients and their parents who were expected to have a stay in hospital of at least three days and/or three days following surgery. The nature of the research was explained to parents and children with information and consent

forms being distributed. Parents and children were provided with the opportunity to decide whether they were willing to participate while the investigator/s were outside the room. The PTA Scale was administered in the same manner as will be described for the children in the main hospital sample and those in kindergartens and schools. The reason for having this pilot sample was to determine whether the questions were appropriate for 3 to 6-year-old children and to provide a comparison with the data obtained from children attending kindergartens and schools.

Because of the large developmental variation in the 3-year-old children in terms of their ability to answer the orientation questions, it was thought inappropriate to continue using children within this age-group for the remainder of the research. Of the ten 3-year-old children sampled, the number of orientation questions answered correctly ranged from two to seven out of a possible seven. For this reason, the normative sample consisted of only 4, 5 and 6 year old children.

The questions for the hospitalised children initially included a personal orientation question "When is your birthday?" This was demonstrated to be unreliable with only 10% being able to answer this question correctly and was replaced with the question "What did you eat last" which the majority of the children were able to answer.

The orientation questions for the hospital sample included one more question than for the normative sample which was "Why are you in hospital?" In assessing posttraumatic amnesia, this is an important and relevant question to ask but, of course, could not be administered to children in kindergartens and schools.

Normative Sampling

Kindergartens and schools were chosen to ensure that a variety of cultures and socio-economic groups were sampled from within the central Auckland region. All schools and kindergartens were located within five kilometres of Auckland Hospital. Children were sent home with information sheets and permission forms and only those children who returned signed permission forms participated. Contact details were provided if parents wanted to discuss the research in more detail with the researchers. Permission to carry out this research was obtained through North Health Ethics Committee.

The Starship PTA Scale was administered over four sessions with 24 hours between each testing session. The same testing format as used with the hospital sample was used.

Session 1. All children were seen individually out of the hearing range of other children. The children were asked to answer six questions which represented the orientation to time, place and person questions. If any errors were made, correct answers were given to the children. Children were also instructed to remember a face and name plus three picture cards out of a set of nine. The investigators ensured that the children had encoded these items by distracting them for one to two minutes and then asking the children what they had to remember for the next session. Children were instructed not to write down the answers and/or discuss with anyone what they had to remember.

Session Two and Subsequent Sessions. Within 24 hours, the investigators returned and asked the children to answer all six orientation questions and to recall the five memory items. If the children could not spontaneously recall the face and/or the three picture cards, they were provided with a recognition recall format. Using this format, the children identified the face from three options and pictures from a group of the nine pictures (three being the target stimuli and the other six being non-target stimuli). If the children made any errors, correct answers to the orientation questions and the face/name memory questions were provided. A child's performance on the memory items was not associated with performance on the orientation items as it is in the clinical administration of the scale. This was so each item could be examined separately. The picture cards were changed following each session irrespective of whether the children had identified all three correctly. (This was to reduce any possible confusion the children could experience about which cards they had to remember each time through having seen additional cards under the recognition recall format. Each set of three cards had its own recognition recall set of cards to prevent the children from being confused about exactly which cards they had viewed on each trial). The same procedure was carried out for the third and fourth sessions except that no new picture cards were presented at the fourth and final session. As the aim was to obtain normative data so that pass rates could be objectively defined, in terms of being one standard deviation from the mean, testing was restricted to four sessions.

Results

The means and standard deviations for the orientation and the memory questions across each of the four assessment occasions were calculated.

The variation in the numbers of children across trials is due to discharge from hospital and children being away from school due to sickness. Once a child was away for a session, testing was discontinued but the results for all the previous sessions were included in the data analysis

The results outlined in Table 1 indicate that the orientation questions in the first session were answered fairly correctly by children from the kindergarten/hospital sample aged between 4 and 5 years with 95% of children achieving an initial orientation score between 4.0–6.0/6.0. The majority of 6-year-old children from the kindergarten/school sample were able to answer all the orientation questions correctly with 95% achieving an orientation score between 5.0–6.0. With regards to trials 2–4, which involved the participants answering the orientation questions and recalling the memory stimuli, all three age-groups achieved means in excess of 10/11 for all three trials. There was slightly more variability in the distribution of scores in the 4-year-old age group as indicated by the larger standard deviation for this age-group as compared with the 5- and 6-year-old children.

Table 2 reveals that the results obtained from the small hospital sample were very similar to the results from the kindergarten and school participants. Using the two-sample *t* test, no significant differences between the means were found for the hospital and kindergarten/school samples for any of the age-groups or trials.

It needs to be remembered that the hospital sample were presented with one more orientation question than were the kindergarten participants. However, all the 4-, 5-, and 6-year-old participants answered this question correctly which means that adding this question should not alter the validity of the scale. If using the kindergarten/school norms, this question should not be added to the final score as this question was not administered to the standardisation sample. Eventually more hospital data will be obtained which will allow a more direct normative comparison to be made. The problem with obtaining data from healthy children in orthopaedic wards is that they are often discharged prior to completion of the four sessions.

Table 3 depicts the percentage of respondents in each session answering the orientation questions correctly across the three age-groups in the kindergarten/school sample. Most of the orientation questions were answered correctly by over 90% of the sample in each of the three age-groups across the four testing sessions. The only exception was that 4-year-old children experienced

TABLE 1
Mean Scores and Standard Deviations Over the Four Trials Across the Three Age-Groups Among Kindergarten and Primary School Children

Ages	Trial 1			Trial 2			Trial 3			Trial 4		
	n	Mean	(SD)	n	Mean	(SD)	n	Mean	(SD)	n	Mean	(SD)
4	35	5.03/6.00	0.56	35	10.23/11.00	1.17	34	10.41/11.00	1.06	28	10.50/11.00	0.88
5	66	5.03/6.00	0.45	64	10.70/11.00	0.55	63	10.70/11.00	0.59	62	10.56/11.00	0.74
6	45	6.00/6.00	0.37	44	10.68/11.00	0.56	39	10.79/11.00	0.52	39	10.72/11.00	0.69

TABLE 2
 Mean Scores and Standard Deviations Over the Four Trials Across the Three Age-Groups among the Hospitalised Sample of Children.

Ages	Trial 1		Trial 2		Trial 3		Trial 4	
	n	(SD)	n	(SD)	n	(SD)	n	(SD)
4	11	6.09/7.00	11	11.30/12.00	8	11.57/12.00	1	10.00/12.00
5	13	5.92/7.00	13	10.15/12.00	10	10.50/12.00	9	11.00/12.00
6	3	6.67/7.00	3	12.00/12.00	2	12.00/12.00	1	12.00/12.00

more difficulty with answering orientation questions two and three in the first session but experienced no problems in following sessions once they were provided with the correct responses in the first testing session. These questions were “Where do you live” and “What did you last have to eat?”

Table 4 reveals that the majority of the kindergarten/school respondents had no difficulty with remembering the face/name and the three picture cards in each testing session. The 4-year-old respondents initially experienced difficulty with remembering the name of the photographed person but their performance improved over the third and fourth sessions.

Table 5 depicts the mean orientation and memory scores for each of the age-groups, in the kindergarten/school sample, across the four testing sessions. All age groups achieved a mean orientation score in excess of 5 out of 6 and a mean memory score in excess of 4 out of 5 on all four testing sessions.

Discussion

It had been hoped that a PTA Scale could be devised where the typical 4-, 5-, and 6-year-old children would be able to achieve a full score if they were not suffering posttraumatic amnesia. However, such a scale has been impossible to devise because of the developmental variations in children’s cognitive development within these age-groups. Therefore, this scale will be more sensitive for evaluating PTA in those children who have sustained moderate to severe head injuries with the mean plus or minus one standard deviation representing a normal level of performance for each trial.

It needs to be emphasised that the Starship PTA Scale is only suitable for assessing those children who possess age-appropriate receptive and expressive language abilities. Administering this scale to children for whom English is a second language is inappropriate and ill-advised unless the child has developed age-appropriate English skills. Children with a history of learning and academic delays, psychiatric problems or neurological problems should not be administered this scale.

For children who have sustained a mild head injury, duration of posttraumatic amnesia will be best evaluated by asking the child what he/she recalls of the accident prior to being provided with details of the accident from others. It will also be important when determining duration of

TABLE 3

Percentage of Respondents in Each Session Answering the Orientation Questions Correctly Across the Three Age-groups for the Kindergarten/School Sample

Session	Age	Q1	Q2	Q3	Q4	Q5	Q6
Session 1	4	97	89	79	100	97	95
	5	99	97	94	96	97	96
	6	100	98	100	95	98	100
Session 2	4	100	91	91	100	100	94
	5	99	99	97	95	100	97
	6	100	98	98	98	98	100
Session 3	4	100	100	91	100	97	94
	5	98	100	92	100	100	100
	6	100	100	97	97	97	100
Session 4	4	96	96	96	100	100	92
	5	100	98	94	98	100	98
	6	100	100	97	97	100	100

TABLE 4

Percentage of Respondents in Each Session Answering the Memory Items Correctly Across the Three Age-groups for the Kindergarten/School Sample

Session	Age	Face	Name	Picture 1	Picture 2	Picture 3
Session 2	4	94	73	94	91	89
	5	100	90	100	100	99
	6	98	91	95	98	100
Session 3	4	97	88	88	84	81
	5	95	97	98	98	94
	6	100	97	97	95	100
Session 4	4	96	88	96	96	88
	5	97	94	91	95	86
	6	97	92	92	95	100

TABLE 5

Mean Orientation and Memory Scores Across the Three Age-groups for the Kindergarten/School Sample

Session	Age	Mean Orientation Score	Mean Memory Score
Session 1	4	5.26	
	5	5.70	
	6	5.76	
Session 2	4	5.93	4.40
	5	5.95	4.90
	6	5.78	4.70
Session 3	4	5.94	4.53
	5	6.00	4.89
	6	5.92	4.92
Session 4	4	6.00	4.76
	5	5.98	4.80
	6	5.95	4.76

posttraumatic amnesia to have a witness to the accident present as well.

The usefulness of the Starship PTA Scale is firstly that it allows an objective assessment of posttraumatic amnesia in children aged from four years onwards to be carried out. This has not been possible up till this time as Marosszky et al. (1993) established that only non-head injured children, aged 8 years and above, could meet the criteria for the Westmead PTA Scale. Assessing duration of post-traumatic amnesia permits the severity of the child's head injury to be established and therefore the level of rehabilitation required, particularly in the cognitive domain. It is also useful to assess post-traumatic amnesia in children with regards to discharge because it is often very difficult for parents to manage children who are still suffering post-traumatic amnesia.

As the child is generally disorganised and confused while suffering posttraumatic amnesia, comprehensive assessment of cognitive functioning is

ill-advised. This is because a child suffering PTA will tend to do poorly on all measures of cognitive functioning and the actual testing process may serve to agitate the child even further. Mobility and ADL assessments, to identify issues of safety, can be carried out while the child is still in PTA as can functional communication, swallowing and feeding assessments. Due to children suffering PTA being confused and disoriented, children's safety needs to be constantly monitored when carrying out these assessments.

Because of time constraints and children being discharged before completion of the four sessions, we were not able to obtain standardisation data solely from non-head injured hospitalised children. However, little difference was found in the results between hospital and kindergarten/school samples. At this stage, hospital data is still being collected and, in time, more comprehensive norms for hospitalised 4-, 5 and 6-year-old children will be available.

Further research will be conducted investigating the relation between scores on the Starship Posttraumatic Amnesia Scale and longer-term neuropsychological outcome in terms of verbal and non-verbal cognitive functioning, attentional, memory and executive functions. This will enable the researcher to determine whether this scale is as valid, as are other measures of post-traumatic amnesia, in terms of helping to predict longer-term cognitive outcome following head injury of varying degrees of severity.

In summary, the development and piloting of the Starship PTA Scale has allowed for the assessment of posttraumatic amnesia in children aged from 4 years onwards whereas previously it could only be reliably assessed from 8 years of age onwards. As 6-year-old non-head injured children in this study experienced no problems meeting the demands of the scale, it is assumed that the Starship PTA Scale can be used with older children using the criteria of normality as scoring within one standard deviation of the mean on three consecutive days. At this stage, the scale has not been piloted with a traumatic brain injury group which limits its utility. Further research correlating the performance on this scale of children with mild, moderate and severe head injuries with their longer-term neuropsychological outcome is due to be commenced this year.

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Appendix A

Starship Posttraumatic Amnesia Scale: Hospitalised Sample Form

	Answer	+/-	Answer	+/-	Answer	+/-	Answer	+/-
Date								
Time								
1. How old are you?								
2. What did you last have to eat?								
3. Where are you?								
4. Where do you live?								
5. Why are you in hospital?								
6. What is your mother's/father's name?								
7. Is it daytime or night-time?								
8. Face								
9. Name								
10. Picture 1								
11. Picture 2								
12. Picture 3								
Total								

Starship Posttraumatic Amnesia Scale: Kindergarten/Primary School Children Form

	Answer	+/-	Answer	+/-	Answer	+/-	Answer	+/-
Date								
Time								
1. How old are you?								
2. What did you last have to eat?								
3. Where are you?								
4. Where do you live?								
5. What is your mother's/father's name?								
6. Is it daytime or night-time?								
7. Face								
8. Name								
9. Picture 1								
10. Picture 2								
11. Picture 3								
Total								

