
The Westmead Post-Traumatic Amnesia Scale for Children (WPTAS-C) Aged 4 and 5 Years Old

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Assessment of posttraumatic amnesia (PTA) in young children remains problematic. This article details a version of the Westmead PTA Scale, which was adapted for use with children aged 4 and 5 years, and an evaluation of this scale with typically developing children. The Westmead PTA Scale for Children (WPTAS-C) comprises 2 orientation and 4 memory questions, including 2 items involving remembering pictures of familiar objects. Participants included 55 preschool and kindergarten children aged 4 and 5 years. The scale was administered for 4 consecutive days. Ninety-three per cent of the children achieved a score of 6 out of 6 for the final 3 days of the 4-day test period. It is concluded that the WPTAS-C is an appropriate measure of orientation and continuous memory in 4- and 5-year-old typically developing children. Validation of the scale in clinical populations is recommended.

Keywords: brain injuries; posttraumatic amnesia; child, preschool; clinical assessment tools

Determining the severity of a traumatic brain injury (TBI) is critical for the effective management of individuals with TBI in both the acute stages and for later rehabilitation. Early indication of the severity of the injury and estimation of the length of the recovery period is important in planning rehabilitation programs, safe discharge, resource allocation, and predicting outcome (Evans, Bull, Devonport, Hall, Jones et al., 1977). An accurate and reliable construct to determine the severity of TBI is therefore essential.

Constructs such as the depth and duration of unconsciousness (typically measured using the Glasgow Coma Scale) and the severity of post-traumatic amnesia (PTA) have been proposed to measure the severity of a TBI (Evans et al., 1977). The duration of PTA is considered an important predictor of outcome following TBI (Brooks, Aughton, Bond, Jones & Rizvi, 1980; Haslam, Batchelor, Fearnside, Haslam, Hawkins

et al., 1994; Shores, 1989). PTA was initially conceptualised to include loss of consciousness, disorientation and an inability to respond intellectually (Russell, 1932; Symonds & Russell, 1943). In 1971, this concept of PTA was modified to incorporate a failure of continuous memory that refers to the inability to recall ongoing events in a sequential manner (Russell, 1971).

Research with adults with TBI has yielded a number of scales that purport to measure the duration of PTA. These scales, however, cannot be assumed appropriate for use with children. Three of these adult scales have been modified for use with children: the Galveston Orientation and Amnesia Test (GOAT; Levin, O'Donnell, & Grossman, 1979), the Oxford Scale (Artiola i Fortuny, Briggs, Newcombe, Ratcliff, & Thomas, 1980) and the Westmead PTA Scale (WPTAS; Shores, Marosszeky, Sandanam, & Batchelor, 1986).

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Children's Orientation and Amnesia Test (COAT)

In 1990, the adult GOAT was modified to form the COAT (Ewing-Cobbs, Levin, Fletcher, Miner, & Eisenberg, 1990; see Table 1). The COAT has several shortcomings. First, the scale has only one item (recall of the examiner's name) that measures the cardinal characteristic of PTA; ongoing or continuous memory. Second, the COAT considers a child to be in PTA if their score falls more than 2 standard deviations below the age-corrected mean obtained from a normative sample. This means that a child with a TBI can be considered out of PTA even when they are unable to recall the examiner's name; that is, the one question testing ongoing memory. Third, responses can be inconsistent from one day to the next, but the child may still be considered out of PTA if their score falls within the normal range.

The Oxford Scale (Modified for Children)

In 1992, the Oxford Scale (see Table 1) was simplified for children (Ruijs, Keyser, & Gebreels, 1992) and shown to be a reliable measure of the duration of PTA in children less than 5 years. There is no published manual, however, and the picture cards used in this study are not commercially available.

The Westmead PTA Scale (WPTAS)

The WPTAS (Marosszeczy, Ryan, Shores, Batchelor, & Marosszeczy, 1998; Shores et al., 1986; see Table 1) was developed from the Oxford Scale. It is a commonly used measure of PTA in Australia and the United Kingdom. Once a full score is obtained on the 12 items of the WPTAS, three of the continuous memory prompts are changed each day until the patient achieves a full score of 12 out of 12 for 3 consecutive days. Patients are said to be out of PTA on the first day of the 3 consecutive days. The duration of PTA is calculated from the time of the trauma including the coma period.

Criticisms have been levelled at the WPTAS, including that the number of orientation items may be redundant, the facial recognition item is flawed, and changes in hospital staff administering the scale may lead to confusion in patients (Forrester, Encel, & Geffen, 1995). Recent research suggests that the end of PTA be operationally defined as the first day of a score of 12 out of 12 in cases where the duration is longer than 1 month (Tate, Pfaff, Baguley, Marosszeczy, Gurka et al., 2006).

Marosszeczy and colleagues (Marosszeczy, Batchelor, Shores, Marosszeczy, Klein-Boonschate et al., 1993) examined the applicability of the WPTAS to children. The scale was administered to orthopaedic inpatients aged between 6 and 16 years over 4 consecutive days. The researchers found that 94% of children aged 8 and above were able to meet the scale's criteria for being considered out of PTA; that is, achieve a full score for 3 consecutive days. They concluded that the WPTAS is appropriate for children aged 8 and above. Only 15% of children aged 6 and 7 years were able to achieve a full score for 3 consecutive days on the WPTAS. Closer examination of their performance revealed that 6- and 7-year-olds had most difficulty with temporal orientation items, especially their date of birth. Ninety percent of 6- and 7-year-olds were able to correctly recall the continuous memory picture items. In a clinical setting, this means that potentially 1 in 10 6- and 7-year-olds may be misdiagnosed as being in PTA if PTA testing consisted of only picture recall. The rate of misdiagnosis would be much higher if orientation items were included. With or without the orientation items, the WPTAS is not appropriate for children younger than 8 years.

The Starship Post-Traumatic Amnesia Scale

The Starship Post-Traumatic Amnesia Scale (see Table 1) has also been developed based on the WPTAS (Fernando, Eason, Faulkner, Moodley, & Setchell, 2002). Attempts to date have failed to construct a scale where 4- to 6-year-old children are able to achieve a full score when not in PTA. Fernando and colleagues (2002), therefore, adopted an operational definition of PTA whereby a child was deemed to be in PTA if he/she could not achieve a score within one standard deviation of an age corrected mean for 3 consecutive days. This operational definition, however, leads to the same shortcomings as the COAT. That is, children may be considered out of PTA if their score falls within one standard deviation of the mean of the normative sample even if their responses are inconsistent from one day to the next.

Rocca (2001) identified a need for a scale that reliably measured PTA in younger children. She modified the WPTAS, with the aim of developing a scale on which typically developing 4- and 5-year-old children could achieve a full score, thus avoiding the weaknesses of both the COAT and the Starship PTA Scales.

The current research, therefore, proceeded in two parts. First, the WPTAS was modified, with the aim of having typically developing 4- and 5-year-old children able to reliably respond correctly to all

TABLE 1
Description of Posttraumatic Amnesia Tests for Children

	Children's Orientation and Amnesia Test (Ewing-Cobbs et al., 1990)	Oxford Scale (modified for children) (Ruijs et al., 1992)	Westmead PTA Scale (Shores et al., 1986)	Starship PTA Scale (Fernando et al., 2002)	The Westmead PTA Scale for Children (Rocca, 2001)
Adult precursor	Galveston Orientation and Amnesia Test (GOAT) (Levin et al., 1979)	The Oxford Scale (Artiola i Fortuny et al., 1980)	The Oxford Scale (Artiola i Fortuny et al., 1980)	The Westmead PTA Scale (Shores et al., 1986)	The Westmead PTA Scale (Shores et al., 1986)
No. of items	16	23	12	12	6
Domains assessed and items	<p><i>General orientation</i></p> <ol style="list-style-type: none"> 1. What is your name? 2. How old are you? 3. When is your birthday? 4. Where do you live? 4. What is your father's name? 4. What is your mother's name? 5. What school do you go to? What grade are you in? 6. Where are you now? 7. Is it daytime or night time? 	<p><i>Orientation to time, place and person</i></p> <ol style="list-style-type: none"> 1. What is your name? 2. How old are you? 3. When is your birthday? 4. How many brothers and sisters do you have? 5. Do you go to school? 6. Which grade are you in? 7. Do you know where you are? 8. How long have you been here? 9. What have you just done/eaten? 10. What did you do today? 	<p><i>Orientation to time, place and person</i></p> <ol style="list-style-type: none"> 1. How old are you? 2. What is your date of birth? 3. What month are we in? 4. What time of day is it? (morning, afternoon or night) 5. What day of the week is it? 6. What year are we in? 7. What is the name of this place? 	<p><i>Orientation</i></p> <ol style="list-style-type: none"> 1. How old are you? 2. What did you last 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? 	<p><i>Orientation</i></p> <ol style="list-style-type: none"> 1. How old are you? 2. What is the name of this place?

TABLE 1 (continued)
Description of Posttraumatic Amnesia Tests for Children

	Children's Orientation and Amnesia Test (Ewing-Cobb's et al., 1990)	Oxford Scale (modified for children) (Ruijs et al., 1992)	Westmead PTA Scale (Shores et al., 1986)	Starship PTA Scale (Fernando et al., 2002)	The Westmead PTA Scale for Children (Rocca, 2001)
Domains assessed and items (cont.)	<p><i>Temporal orientation</i></p> <p>8. What time is it now?</p> <p>9. What day of week is it?</p> <p>10. What day of the month is it?</p> <p>11. What month is it?</p> <p>12. What is the year?</p> <p><i>Immediate short-term and remote memory</i></p> <p>13. Say these numbers after me in the same order.</p> <p>14. How many fingers am I holding up?</p> <p>15. Who is on Sesame Street?</p> <p>16. What is my name?</p>	<p><i>Retrograde amnesia</i></p> <p>11. What happened?</p> <p>12. How/when did it happen?</p> <p>13. What were you doing?</p> <p>14. What were you doing before?</p> <p>15. Were you unconscious?</p> <p>16. Did you sleep?</p> <p>17. When did you wake up?</p> <p>18. Where were you then?</p> <p>19. What happened then?</p> <p><i>Continuous memory</i></p> <p>20. Target picture 1</p> <p>21. Target picture 2</p> <p>22. Target picture 3</p>	<p><i>Continuous memory</i></p> <p>8. Do you remember me?</p> <p>9. What is my name?</p> <p>10. Target picture 1</p> <p>11. Target picture 2</p> <p>12. Target picture 3</p>	<p><i>Continuous memory</i></p> <p>8. Do you remember me?</p> <p>9. What is my name?</p> <p>10. Target picture 1</p> <p>11. Target picture 2</p> <p>12. Target picture 3</p>	<p><i>Continuous memory</i></p> <p>3. Do you remember me?</p> <p>4. What is my name?</p> <p>5. Target picture 1</p> <p>6. Target picture 2</p>
Criteria for out of PTA	Two consecutive days of scores within two standard deviations of their age-corrected mean.	A full score of 22 out of 22 for 3 consecutive days	A full score of 12 out of 12 for 3 consecutive days	Achieves a score within one standard deviation of an age corrected mean for 3 consecutive days	A full score of 6 out of 6 for 3 consecutive days
Age	3–15 years < 8 years not administered	3.5–10 years < 5 years continuous memory assessed with familiar objects	≥ 8 years	4–6 years	4–5 years

items (Rocca, 2001). Second, and as reported in the body of this article, the performance of a sample of typically developing 4- and 5-year-old children on the WPTAS for Children (WPTAS-C) was investigated.

Part 1: Adapting Item Content of the Westmead PTA Scale

Rocca (2001) used the WPTAS to test 46 4- and 5-year-old children recruited from preschools and kindergartens. The sample consisted of 29 girls and 17 boys. The participants' median age was 5 years 4 months (range = 3 years 11 months to 6 years 2 months). Item 2 (*What is your date of birth?*) was excluded as it has been established that 4- and 5-year-old children cannot reliably recall their date of birth (Ewing-Cobbs et al., 1990). Rocca found that some of the orientation items and the continuous memory picture items were found to be unsuitable for this age group. Forty-five per cent of 4- and 5-year-olds, for example, had difficulty responding to temporal orientation items (*What month are we in? What time of day is it, morning, afternoon or night time? What day of the week is it? What year are we in?*). Ninety-eight per cent and 93% of 4- and 5-year-old children, however, responded correctly to the items orientating to person and place respectively. All of the 4- and 5-year-old children were able to respond correctly to 'Do you remember me?' while 98% responded correctly to 'What is my name?'. None of the children were able to correctly remember the target picture cards.

Based on these findings Rocca (2001) reduced the number of orientation questions. Rocca also modified the continuous memory picture card procedures based on existing literature regarding memory in young children. This was achieved by investigating the effects of four different conditions on the recall of the continuous memory items in 26 typically developing 4- and 5-year-old kindergarten and preschool children. The four conditions provided were a categorical cue only, a time delay (thus eliminating the effect of successive presentations of items), a visual cue, and a visual cue plus a model. The categorical cue consisted of three sets of nine picture cards: the standard WPTAS cards (OBJECTS), coloured farm animal picture cards (FARM ANIMALS), and fruit and vegetable picture cards (FRUIT AND VEGETABLES). The time delay involved a 3- to 4-hour period between recall of the pictures presented on the previous day and presentation of the next set of picture cards. The visual cue consisted of props that were paired with the three sets of picture cards (toy house paired with objects, farmhouse paired with farm

animals, toy shopping trolley paired with fruit and vegetables). In the last condition, visual cue plus model, small three-dimensional models of the items in the picture cards were substituted for the picture cards.

Rocca (2001) found that although the introduction of a categorical cue enhanced young children's performance, the majority (operationalised as 95%) could not recall three out of three picture cards. The addition of a time delay, a visual cue and a three-dimensional model did not further augment performance. Retrospective examination of the responses of all the children indicated that reduction of the target items from three to two, plus the provision of a categorical cue, resulted in more than 95% of children achieving a full score. An additional 20 children between the ages of 4 and 5 years were then recruited and administered the WPTAS, with these modifications to the continuous memory items and the reduced number of orientation questions. Ninety-five per cent of participants achieved a full score over 4 consecutive days.

Consequently, Rocca (2001) proposed the use of this adapted version, the WPTAS-C, with 4- and 5-year-old children, which consisted of six items: two orientation items and four items assessing continuous memory (see Table 1). The majority of the typically developing children were able to correctly respond to the items testing facial recognition and examiner's name. These items were, therefore, retained in the WPTAS-C, despite criticism of their use in a hospitalised population (Forrester et al., 1995).

Part 2: Empirical Testing of the Westmead PTA Scale for Children (WPTAS-C)

The current study explored the performance of a sample of typically developing 4- and 5-year-old children on the WPTAS-C. The study hypothesis was that the majority, operationalised as 95%, of typically developing 4- and 5-year-old children who have not sustained a TBI would be able to achieve a full score of 6 out of 6 on the WPTAS-C on each day of testing over 3 consecutive days. Ninety-five per cent was chosen as the criteria as it was deemed essential to devise a tool that had only a small chance of misclassifying subjects. This would allow us to consider that, in applying these results to a sample of children with TBI, 95% of children who were out of PTA would be correctly diagnosed as being so. Differences in test scores according to age, sex and socioeconomic status were also examined to determine any impact of these factors on test responses.

Methods

Participants

Participants were recruited from three public primary schools located in the inner western suburbs of Sydney, Australia and nine day-care centres and preschools located in the inner western, northern and western suburbs of Sydney, Australia. These were typically developing children who: (1) attended school, preschool or day-care for 4 consecutive days, (2) were aged 4.0 to 6.0, and (3) had adequate English skills to allow completion of testing were eligible for inclusion. A sample of at least 50 children was deemed necessary in order to gauge any variations in memory and orientation in children of 4 and 5 years.

Ethics approval was obtained from the NSW Department of Education and Training and Macquarie University. Directors of day-care centres and preschools gave approval for their facilities to participate. Informed parental consent was obtained for each participant. On each day of testing verbal assent to participate was obtained from each child. Data was collected over a 12-month period from January 2004 to January 2005.

Materials

The WPTAS-C was used to measure the two fundamental attributes of PTA: disorientation and the inability to learn new material (see Table 1). Stimulus material for items 5 and 6 were three sets of six picture cards. One set was OBJECTS, consisting of six of the nine standard black and white picture cards from the original WPTAS (Shores et al., 1986). The other sets consisted of six coloured picture cards of FARM ANIMALS and FRUITS AND VEGETABLES. Socioeconomic status was measured using Daniel's Scale of Occupational Prestige based on father's occupation (Daniel, 1983). This scale ranges from 1.0 to 6.9 where a low score reflects high occupational status.

Procedure

On day 1 of testing, the examiner (AR) introduced herself and then administered item 1 (*How old are you?*) and item 2 (*Where are you?*) from the WPTAS-C. Correct responses received a score of 1 and incorrect responses received a score of 0. If the participant responded incorrectly, the examiner provided the correct response. However, if a participant failed to spontaneously respond or answered 'I don't know', then recognition memory was examined by providing three multiple-choice responses (following the same procedure as the adult WPTAS (Marosszky et al., 1998)). For example, the choices for item 1, 'How old are

you?' were: 'Are you 4, 5 or 6?'. A correct response received a score of 1 and an incorrect response a score of 0. The three multiple-choice options for item 2 were 'Are you at home, school or hospital?' and were scored in the same manner as item 1 and corrected if incorrect. Next, participants were asked to remember the examiner's name and face for the next day (items 3 and 4). Finally, participants were presented with two target pictures from one of the picture sets. The participants were asked to remember these pictures for the next day. In order to facilitate encoding of this new information, the child was distracted for 1 minute and then asked to recall the information that they had to remember for the next day. This was repeated until they had accurately learnt the new material. Participants were asked not to write down or discuss with anyone what they had to remember.

On days 2, 3 and 4 the participants were administered all items. If the participant did not respond spontaneously to items 1 to 4, then recognition was tested using multiple-choice responses. Incorrect responses were corrected. Participants were then asked to recall the two target pictures. If the participants did not respond spontaneously then recognition was tested by laying out all six picture cards from that set and asking the participant to pick out the two target pictures. If participants correctly responded to all six items on the scale then they were presented with two new target pictures from a different set and asked to remember them for the next day. If the child received a score less than 6 out of 6 the same two target picture cards were re-presented to remember for the next day. Target picture cards were only changed when the participant received a full score of 6 out of 6. Testing continued for 4 consecutive days regardless of test scores.

Data Analysis

Chi-square tests were used to investigate differences between the proportion of children achieving 6 out of 6 during the test period and the hypothesised 95% target. Participants were then divided into two groups according to (a) median age: younger group (28 children below the median age) and the older group (27 children above the median age); and (b) occupational prestige: high (below the median occupational prestige score of 4.0, $n = 28$) and low (above the median occupational prestige score of 4.0, $n = 23$). Chi-square tests were also used to examine differences within each of these categories and in regard to sex.

Results

Fifty-nine participants provided informed consent. Four participants were away sick during the testing period and did not complete four consecutive days of testing. These children were excluded from the study. Therefore, the sample consisted of 55 participants, 27 boys and 28 girls. The participants' median age was 5 years 4 months (range = 4 years 2 months to 6 years 0 months). Occupation was obtained from 51 of 55 parents to allow completion of the Daniel's Scale of Occupational Prestige (Daniel, 1983). Scores ranged from 1.9 to 5.9, with a median of 4.0.

Fifty-one of the 55 participants (93%) achieved a full score of 6 out of 6 on the WPTAS-C on each day of testing. This was not significantly different from the hypothesis that 95% of participants would meet the scale's criteria, $\chi^2(1, N = 55) = .598, p = .439$. Power for this analysis was 12%.

The four participants who did not achieve a score of 6 out of 6 over the 4 days of testing were aged between 4 years 4 months and 5 years 9 months. Three of these participants incorrectly responded to a picture item and one to item 4 (*What is my name?*).

There was no significant difference in the proportion of children achieving 6 out of 6 between the younger and older age groups, $\chi^2(1, N = 55) = 1.002, p = .317$, high and low occupational status groups, $\chi^2(1, N = 51) = 1.567, p = .211$, or between boys ($n = 27$) and girls ($n = 28$), $\chi^2(1, N = 55) = 0.01, p = .970$. Power for these analyses were 17%, 24% and 5% respectively.

Discussion

Previous attempts to develop a scale in which 4- and 5-year-old children are required to achieve a full score on each day of testing to be deemed out of PTA have been unsuccessful (Fernando et al., 2002). The current study presents a developmentally appropriate adaptation of the original WPTAS for 4- and 5-year-old children. Results revealed that 93% of a typically developing sample of 4 and 5-year-old children were able to achieve a score of 6 out of 6 over 3 consecutive days. This result was not significantly different from the 95% criterion adopted for this study. In addition, 95% of Rocca's (2001) independent sample of 20 children who were 4 and 5 years old achieved a full score on the WPTAS-C. The WPTAS-C can therefore be considered an appropriate measure of orientation and continuous memory in 4- and 5-year-old typically developing children and may form a useful foundation

for future research in evaluating this scale in clinical populations.

This study also indicated that the WPTAS-C was appropriate for 4- and 5-year-old children regardless of sex or socioeconomic status. There was no significant difference in scores between boys and girls or between children from high or low socioeconomic status on the WPTAS-C.

Currently, the only other objective and available measures of the duration of PTA in 4- and 5-year-old children are the COAT and the Starship PTA Scale. Advantages of the WPTAS-C are that its operational definition requires children to achieve a full score across testing days and it measures the two keys concepts of PTA, disorientation and the failure of continuous memory. Further comparison of the relative utility of these tests would be worthwhile.

The facial recognition and examiner's name items of the original WPTAS have been criticised when used with clinical populations (Forrester et al., 1995). These items did not pose a difficulty for the typically developing sample in this study. Removing these items from the WPTAS-C would result in a loss of one third of the items. Inclusion may be reconsidered following research with hospitalised controls and children with TBI.

The findings from the current study provide preliminary evidence for the WPTAS-C as a measure of the duration of PTA in 4- and 5-year-old children. The scale was administered to children from several Sydney suburbs and children from a wide range of socioeconomic status. One limitation of the generalisability of the findings is that children were tested in a school or day-care setting. Furthermore, low power for the current analyses suggests replication with a much larger sample size. Future research should investigate the effects of hospital environment on the scores of the WPTAS-C. Validation studies within a sample of children with TBI are also required. In addition, further research to extend the WPTAS-C to 6- and 7-year-old children is warranted.

The WPTAS-C offers allied health, nursing and medical staff an objective and standardised measure of the duration of PTA in 4- and 5-year-old children with TBI. Such a measure can provide an early indication of the severity and prognosis of brain injury which is important for developing and implementing rehabilitation programs as well as predicting outcomes following TBI (Evans et al., 1977). Amnesia and poor new learning ability in a person following TBI can impede the rehabilitation process. A rehabilitation program can be modified and intensified when a person is clinically assessed to be out of PTA, and

therefore more able to benefit from rehabilitation. An objective measure of PTA in 4- and 5-year-old children will also assist with making decisions about safe and timely discharge of children from inpatient facilities.

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