DISSERTATION

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RUNNING HEAD: Child memory questionnaire

Development of a children's memory questionnaire

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ABSTRACT

The Everyday Memory Questionnaire (EMQ) (Sunderland, Harris & Baddeley, 1983) was examined for its suitability to assess children's memory function. The parents of 226 school children (aged from 6 to 12 years) completed the EMQ in relation to their children. A factor analysis conducted on these data revealed a structure similar to that found in adult EMQ data (Cornish, 2000; Richardson & Chan, 1995) including factors associated with memory for everyday activities, expressive and receptive language, and visuo-spatial orientation. The validity of the EMQ was further assessed using 101 of these children in the 6, 8 and 10 years age groups who completed subtests of the Wide Range Assessment of Memory and Learning (WRAML) (Sheslow & Adams, 1990). In the 10 years age group aspects of verbal memory tests correlated moderately with the EMQ. There were only very low and unreliable correlations in the 8 years age group and in the 6 years age group aspects of visual memory correlated moderately with the EMQ. Preliminary data on the diagnostic utility of the EMQ for children with memory deficits was collected by comparing EMQ performance between school children and a clinical group with ADHD and/or learning disorders. Although there was a significant difference between the means on the EMQ between the school and clinical groups, diagnostic indicators demonstrated that the EMQ had poor positive predictive power in this situation and miscategorized 40% of the school group.

There has been an increasing number of psychological tests available in recent years to assess children's memory (e.g. The Wide Range Assessment of Memory and Learning (WRAML)(Sheslow & Adams, 1990). Other instruments such as checklists and questionnaires are popular in some areas of child behaviour and development (e.g. Child Behavior Checklist, Achenbach & Edelbrock, 1986; Behavior Rating Inventory of Executive Function; Gioia, Isquith, Guy & Kenworth, 2000) and although memory may be addressed in such instruments, assessment of memory deficit is not the main concern. Since questionnaires can be an economical and efficient means to acquire information about an individual, a memory questionnaire for children could be useful as a diagnostic aid and to provide information pertinent for rehabilitation.

Memory questionnaires for adults have been popular in an area of research referred to as "everyday" memory. They have arisen from a desire to make memory research and assessment more "ecologically" or externally valid and were inspired by the dissatisfaction of some researchers with what they argued was the unrealistic nature of memory testing and research (e.g. Neisser, 1978). Such questionnaires address a wide range of memory phenomena, some not amenable to formal testing such as memory for events weeks and months distant; memory in diverse situations and circumstances (such as memory for usual or unusual events, memory according to different levels of motivation), memory with environmentally or personally enriched contextual cues; and skill or procedural memory (Berry, West & Dennehey, 1989; Bennett-Levy & Powell, 1980; Gilewski, Zelinski & Schaie, 1990; Herrmann & Neisser, 1978; Sunderland, Harris & Baddeley, 1983). This type of memory questionnaire does not directly assess memory but instead requires individuals to

judge memory performance (Herrmann, 1984). Such judgements are informed by memory performance over months and years avoiding one problem of formal testing which is that memory is sampled on only one or two occasions. A ramification of this is that these memory questionnaires can have good retest reliability or stability (Herrmann, 1982; Herrmann 1984; Morris, 1984) which might make them suitable to assess memory over time.

Reliability and validity are the two main criteria on which psychological measuring instruments are evaluated (Dawis, 1998). Validity is generally divided into content, construct, and criterion validities. Construct validity is probably the most important aspect of validity (Clark & Watson, 1998) and is the extent to which a test measures a theoretical construct (Anastasi, 1988). Information on construct validity requires accumulation of information from a variety of sources (Anastasi, 1988; Clark & Watson, 1998), one being correlation with other similar tests. Factor analysis can also be used to assess construct validity by isolating factors and comparing them to psychological constructs (Anastasi, 1988). Criterion related validity refers to validating test performance against a criterion such as job performance or a medical diagnosis.

These types of validity are not exclusive, indeed construct validity is a comprehensive concept which encompasses the others (Anastasi, 1988). Messick (1998) also points out that construct validity subsumes the other types as content validity is content relevance and coverage, and criterion validity is either predictive and/or diagnostic utility.

This aspect of validity (diagnostic utility) of questionnaires, ratings scales and other clinical assessment tools has been attracting increasing notice over recent years. As Baldessarini,

Finklestein & Arana (1983) pointed out the testing of clinical diagnostic tools typically occurs in a clinical setting where the diagnostic status is already known. This provides only limited information however, such as establishing cutoff points for abnormality and does not explore false or misleading results, such as the numbers of individuals incorrectly categorized by the diagnostic instrument. The first step in examining diagnostic validity is to establish the sensitivity and specificity in already diagnosed groups. Sensitivity refers to true positives, which is the probability that a test accurately identifies an individual as having the disorder, for example the proportion scoring above the cutoff score. Specificity refers to true negatives and is the probability that a test accurately identifies an individual as not having the disorder, for example the proportion below the cutoff score (Baldessarini et al., 1983).

The predictive power of a test takes into account false positives (when the test inaccurately identifies an individual as having the diagnosis) and false negatives (when the test inaccurately identifies an individual as not having the diagnosis) and also the prevalence of the condition. Predictive power concerns the conditional probabilities of the true/false positives/ negatives with the prevalence rate. Positive predictive power (PPP) is the rate of true positives compared to all positives, and negative predictive power (NPP) is the rate of true negatives compared to all negatives (Baldessarini et al., 1983). Tests are not always required to be high in all characteristics to be useful as it is the interaction of these characteristics and the requirements of a particular situation which determine the utility of a test. For example in a screening program, tests with high sensitivity and at least moderate specificity are useful when results are negative and prevalence is low. In this case a disorder can be reliably ruled out (Baldessarini et al., 1983).

There are some issues which arise in establishing the validity of memory questionnaires which do not arise in validating formal memory tests. Morris (1984) lists five stages necessary for accurate questionnaire ratings: the person must have the memory failure described in the questionnaire item, classify it as a failure, remember the failure later, judge the failure to be reportable, and finally classify or describe it accurately according to the ratings categories. Failure at any stage undermines the validity of the questionnaire. Remembering the failure later is problematic for people who have memory deficits. However, even people with normal memory function may not be good judges of their own memory performance as this judgement, like other self-reports, can be affected by psychological aspects of the individual such as self-efficacy (Berry et al., 1989; Hertzog, Hultsch & Dixon, 1989). Self rating has further problems with children as their developmental status may make them poor judges of their own memory and unable to cope with the literacy demands of a questionnaire. Some of these problems may be overcome or ameliorated by avoiding self rating and using family members and carers to rate an individual's memory (Herrmann,1982).

The Everyday Memory Questionnaire (EMQ) was developed by Sunderland et al., (1983) using head injured patients and orthopaedic controls and addressed some of the validity problems associated with memory questionnaires. They used self rating by the spouse or carer and chose items over a wide range of memory failures that patients had the opportunity to make and which pilot work had shown were typical of the clinical population they used. Five categories of failure were covered: speech, reading and writing, faces and places, actions, and learning new things.

A range of formal memory tests was used to establish construct validity including face

recognition; story memory (immediate and delayed recall); paired associate learning (immediate and delayed recall); forced choice word recognition; a vocabulary test; and a semantic memory reaction time (RT) task which measured RT to rate statements such as "U.S. presidents have wings" as true or false. The patients completed formal memory testing and rated their own memory on the questionnaire, and the carers completed the questionnaire in relation to the patient in their care. Correlations between the questionnaire total and results from the memory tests can be seen in Table 1 and show that while there was low validity

Table 1. Correlations between the total score on the Everyday Memory Questionnaire and results of memory tests in head injured and orthopaedic control patients and their carers.

Memory Test	HI patients	HI carers	Control patients	Control carers
Face Recognition	.14	.28	.01	#
Story immediate	.36*	.72**	-.25	.41**
Story delayed	.35*	.63**	-.17	.37**
PA immediate	-.14	.28	.22	.33*
PA delayed	.06	.47**	.21	.45**
PA % forgotten	.36*	.44**	.02	.23
Vocabulary	.13	.1	.09	.14
Semantic memory	.15	.16	-.01	.24

HI = Head Injury; PA = paired associate learning test. The signs of the correlation coefficients have been adjusted so a positive correlation indicates an association between poorer test performance and more memory complaints. (# indicates data missing in Sunderland et al. 1983.) (From Sunderland et al., 1983.)
* $p < .05$
** $p < .01$

between patients' questionnaire ratings and test results, the validity improved with carers' ratings.

Other studies have also assessed the validity of the EMQ and found moderate to low correlations (.4 to .62) between the EMQ and the Rivermead Behavioural Memory Test (RBMT) (Koltai, Bowler & Shore,1996; Lincoln & Tinson,1989; Stewart, Sunderland & Sluman, 1996; Sunderland, Stewart & Sluman, 1996). Lincoln & Tinson (1989) also compared EMQ totals for stroke patients with memory for stories and paired associate learning and found low but significant correlations for the relatives (-.27 to -.31) and slightly lower for the patients (-.21 to -.28). In addition to the RMBT, Koltai et al., (1996) used the Wechsler Memory Scale-Revised (WMS-R) and found significant moderate correlations (.5) with patient and relative ratings between the EMQ and WMS-R.

Further validation was established in studies which showed significant differences on the EMQ total score between clinical and normal groups or between severe and mild injury groups in head injury, stroke, and multiple sclerosis (Sunderland et al.,1984; Sunderland et al.,1996; Richardson,1996; Tinson & Lincoln, 1987). None of these studies, however, assessed the diagnostic indicators of the EMQ.

Factor analysis has also been used to validate the EMQ. Cornish (2000) used university students to study the relationship of the EMQ to theoretical constructs of memory. A five factor solution was accepted which explained 48.5% of the variance. The factors were described as "retrieval" which concerned prospective and retrospective memory for events; "task monitoring"; "memory for activities"; "conversational monitoring"; and "spatial

memory". Richardson & Chan (1995) conducted a factor analysis of the EMQ using scores from a group of multiple sclerosis patients and their relatives. They accepted a five factor solution which accounted for 62.1% of the total variance. The factors were: "receptive communication", "route finding", "absent mindedness", "face recognition", and "expressive communication".

Research described above suggests that the EMQ may be a useful questionnaire instrument to assess memory in adults. It has been shown to have reasonable correlation with formal memory tests, especially verbal memory, and its factor structure is interpretable with respect to the psychological processes of memory. Additionally it can be used by the carers of individuals with memory problems, rather than the individuals themselves which suggests that it might be suitable for parents to complete in relation to their children. It covers a range of memory problems which, importantly, children have the opportunity to make and that parents have to opportunity to observe.

Memory deficits in children

Due to the widespread nature of memory networks and systems in the brain, memory is very vulnerable to brain insult. Children can experience memory deficits across all aspects of memory function resulting from acquired and developmental problems including head injury (Donders, 1993; Ponsford, 1995) brain tumours and their treatment (surgical and radiological) (Ris & Noll, 1994), epilepsy (Jambaque, Dellatolas, Dulac, Ponsot, & Signoret, 1993), insulin dependent diabetes (Hershey, Craft, Bhargava & White, 1997), spina bifida (Yeates, Enrile, Loss & Blumenstein, 1995), pre-term and low/very low birthweight children (Luciana, Lindeke, Georgieff, Mills & Nelson, 1999), foetal alcohol sydrome (Kerns, Don, Mateer, &

Streissguth, 1997) and genetic disorders such as neurofibromatosis (Joy, Roberts, North & de Silva, 1995) and phenylketonuria (Spreen, Risser & Edgell, 1995).

Memory deficits have also been observed in children diagnosed with developmental disorders, such as learning disorders (LD) and Attention Deficit Hyperactivity Disorder (ADHD). The aetiology of such disorders is uncertain, however central nervous system anomalies have been found in these disorders such as unusual morphology, volume differences, and lateralization differences in areas considered important for these disorders such as auditory and language regions in LD and frontal regions in ADHD (Filipek, 1999).

Although both short and long term memory problems have been associated with LD (Anderson & Gilandas, 1994; Kaplan, Dewey, Crawford & Fisher, 1998; Swanson, 1999), working memory, in particular the phonological loop (Baddeley & Hitch, 1974), has been implicated in reading and spelling problems. LD readers have been found to have poor performance on span tasks and the recall of strings of spoken words and sentences (Gathercole & Baddeley,1989; Siegel & Ryan, 1989; Roodenrys, Koloski & Grainger, 2001). Deficits in working memory have also been frequently observed in ADHD children (Barkley, 1997; Pennington & Ozonoff, 1996). Barkley views such deficits as being secondary to poor inhibitory control which does not permit sufficient time for working memory processes to effectively operate.

The idea of long term memory problems with ADHD has been more controversial and Kaplan et al., (1998) found no evidence for deficits in delayed recall in ADHD children when performance was measured as a proportion of the material immediately recalled. They

concluded that the memory deficits associated with ADHD are actually executive deficits in attention, planning, organization, and rehearsal strategies and entail no loss of information once acquired.

These executive functions have also been referred to as control processes of memory (Atkinson & Shiffrin, 1968) or memory strategies (Bjorklund & Douglas, 1997) and are concerned with rendering material more memorable. Maintenance rehearsal is the repetition of material to maintain its activation; elaborative rehearsal is the association of incoming information with related concepts in long term memory; coding refers to the modality of input and might involve recoding visual material to verbal format; and organization encompasses many techniques including arranging material according to semantic category which could assist retrieval. Children develop from being unable to use these strategies, even with instruction, to using them with instruction and finally to spontaneous use of strategies at 10 to 12 years of age (Bjorklund & Douglas, 1997). For example, younger children do not use subvocal rehearsal to maintain activation in short term memory as older children and adults do, and younger children do not spontaneously recode visual material into verbal code to assist memorization, making them more dependent on visual short term memory than older children and adults. This results in the memory of older children and adults being more verbally mediated than that of younger children (Gathercole 1998).

Learning and memory are intimately linked and disruption to memory will inevitably mean an ensuing disruption in learning. It is therefore crucial that memory problems in children are detected as soon as they appear so that they can be fully assessed and remediation programs put in place in the school and home. A memory questionnaire could be a useful tool for this

detection.

The purpose of the present study was to assess the suitability of the Everyday Memory Questionnaire (Sunderland et al., 1983; Sunderland et al.,1984) as an instrument to assess children's memory function. Its relationship to the results of formal memory tests in a sample of school children was explored and its relationship to memory constructs established by factor analysis. Preliminary information was also gathered in relation to a clinical group (children with LD and ADHD), comparing performance on the EMQ with that on formal memory tests and establishing the diagnostic indicators of the EMQ with these groups of children.

METHOD

Participants

The total number of subjects was 261 from ages 5 years to 12 years (see Table 2). In the school group there were 226 participants with 122 females and 104 males, and in the clinic group there were 35 participants with 10 females and 25 males. There were 101 participants in the school group for whom questionnaire as well as formal memory test and intelligence data were collected in 6, 8 and 10 years age groups. In the remaining age groups questionnaire data only were collected.

In canvassing for children in the school group, a statement in the information sheet asked for participation only from children who did *not* belong to any of the following diagnoses/categories: epilepsy, learning disorder, attention deficit disorder or admission to

hospital for any reason. The latter category was over inclusive but it was the most efficient way to ensure a "normal" group when parents were not directly interviewed about their child's medical and learning background. Within the schools only "mainstream" classes were

Table 2. Numbers of participants in each age group

Age in years	School group	Clinic group	Total
5	10*	0	10
6	34	0	34
7	46*	6	52
8	34	9	43
9	33*	5	38
10	33	8	41
11	27*	6	33
12	9*	1	10

* Only questionnaire data collected

accessed. Four primary schools (i.e. from kindergarten to year 6) participated in the study and information and consent forms, together with the questionnaire were sent home with all children in the school. Families could participate by returning the completed questionnaire or the completed questionnaire and consent forms for the cognitive assessment if they had a child in the 6, 8 or 10 years age groups.

The data from the clinic group were archived data which had been collected as part of routine clinical assessments conducted with children who had been referred to a Learning Disorders Clinic of a local hospital over a two year period. Medical records were accessed to acquire these data. See Table 2 for numbers of participants in age groups. Children included in the

study were diagnosed as having a Learning Disorder with reading or spelling problems (N = 8), Learning Disorder with reading or spelling problems + arithmetic problems (N = 13), Learning Disorder with reading and/or spelling problems + Attention Deficit Hyperactivity Disorder (N = 12) and Attention Deficit Hyperactivity Disorder (N = 2). Questionnaire, memory and intelligence test data had been collected from the clinic group.

Materials

The Children's Memory Questionnaire (see Appendix A) was based on the Everyday Memory Questionnaire (EMQ) of Sunderland et al., (1983) and the modified version of this questionnaire used by Sunderland et al., (1984). Sunderland et al., (1983) had found that some items did not discriminate between groups and that performance was at floor level (i.e. never or almost never happened) for all or almost all participants. Some of these floor items were used in the Sunderland et al., (1984) study as a type of validity check or lie scale as found in a personality scale. These items were retained in the children's version as the occurrence of such memory failures in children was not known (see Appendix B for comparison of items between questionnaires).

The questionnaire used for the clinical group was based on the earlier EMQ by Sunderland et al., (1983) and was slightly shorter (30 items) than the one used for the school group (34 items) which used items from both Sunderland et al., (1983) and Sunderland et al., (1984). The clinic questionnaire used 5 ratings categories in line with Sunderland et al. (1983) and the school questionnaire used 7, being a balance between the 5 categories used in Sunderland et al., (1983) and the 9 used in Sunderland et al., (1984).

Since slightly different versions of the EMQ had been used in the two groups the data had to be modified for the analyses comparing the school and clinic groups. Those items from the school questionnaire which were not in the clinic questionnaire were omitted from these analyses (see Appendix B). The ratings also required modification as the 7 ratings categories of the school questionnaire had to be reduced to the 5 ratings of the clinic questionnaire. As it can be seen from Table 3, the first category was the same in both questionnaires ("1 = never or almost never happens") and required no change.

Table 3. Comparison of rating categories from the school and clinic questionnaires with the modified ratings numbers given to the school questionnaire data to allow comparison between the school and clinic data.

Clinic questionnaire	School questionnaire	Modification required for school questionnaire
1 = never or almost never happens	1 = never or almost never happens	None
-	2 = about once in 3 months	None
-	3 = about once a month	Rescored to 2
2 = less than once a week	4 = about once in 1 - 2 weeks	Rescored to 2
3 = once or twice in a week	5 = about once or twice a week	Rescored to 3
4 = about once a day	6 = about once a day	Rescored to 4
5 = more than once a day	7 = more than once a day	Rescored to 5

The categories "about once in 3 months", "about once a month", "about once in 1-2 weeks" of the school questionnaire were deemed equivalent to the clinic questionnaire descriptor "less than once a week" and the ratings numbers changed where necessary to reflect this (see

Table 3). The descriptors for the remaining categories matched, but the ratings numbers in the school questionnaire data were changed to match those of the clinic (see Table 3).

The memory tests used for validation were from the WRAML and were Verbal Learning (immediate and delayed recall), Story Memory (immediate and delayed recall and delayed recognition), Finger Windows, Visual Learning (immediate and delayed recall), and Number Letter. Factor analytic research has shown that these learning subtests do not form a separate learning scale but are related to verbal and visual memory (Burton, Donders, & Mittenburg, 1996; Burton, Mittenberg, Gold, & Drabman, 1999; Dewey, Kaplan, & Crawford, 1997; Goia, 1998). Data from these tests were available for the clinic group with the exception of Story Memory.

The Weschler Intelligence Scale for Children - Third Edition (WISC III) was used for estimating intelligence. In the school group Vocabulary and Block Design only were used and an estimate of FSIQ made from this (Sattler, 1992, in Spreen & Strauss, 1998). In the clinic group the full WISC III had been administered giving Verbal (VIQ) and Performance Intelligence (PIQ) Quotients as well as the Full Scale Intelligence Quotient (FSIQ).

Procedure

Children in the school group were tested at their school and taken out of class for individual assessments. The order of testing was Verbal Learning, Story Memory, Verbal Learning Delayed recall, Finger Windows, Visual Learning, Number Letter, Visual Learning Delayed recall, WISC Vocabulary, WISC Block Design, Delayed Story Memory recall and recognition. Assessment sessions lasted approximately 45 minutes.

Norms were used from the WRAML and WISC III where possible, however in the WRAML there are no age scaled scores for the delayed tests or the separate learning trials from the Verbal and Visual Learning tests and so group means were compiled from the data within each age group.

To assess test-retest reliability, children from two of the participating schools, who had completed the cognitive assessment, were given a second copy of the questionnaire to take home for completion about 3 - 4weeks after their cognitive assessment. Thirty participants completed and returned the questionnaire on a second occasion.

RESULTS

School Data (full questionnaire, 34 items, 7 ratings categories)

The distribution for the questionnaire total scores was positively skewed. A square root transformation of the data did not normalize the distribution and the pattern of results remained the same using either transformed or untransformed data. Therefore non-parametric tests using untransformed data were employed.

The mean total questionnaire scores for each age group can be seen in Table 4 and a Kruskal-Wallis test showed no significant difference in these scores (X^2 (7) = 5.913, $p > 0.5$). Combining all age groups the mean for the total questionnaire was 72.89 (SD 34.41), ranging from 34 to 265. The mean totals for females, combining all ages was 73.26 and for males 72.45. A Mann-Whitney test showed no difference between these means ($U = 6146.5$, $p <$ .05).

Almost all intercorrelations of the items were positive and so the questionnaire total was used as the index.

Table 4. Mean total questionnaire scores according to age groups

Age	M	(SD)	(N)
5	74.30	31.14	10
6	73.97	31.24	34
7	73.13	30.88	46
8	76.62	35.45	34
9	68.39	23.41	33
10	79.94	48.84	33
11	65.37	36.80	27
12	65.11	29.79	9

The highest mean score for any item was 3.7 for Item 1 (Forgets where s/he has put something) and the lowest was 1.06 for Item 30 (Fails to recognize by sight people e.g. relatives or friends that s/he meets frequently) (see Table 5). The highest and lowest means for any item were very similar across all ages (see Table 5). The modal score was 1 (never or almost never happens) for the majority of items but Item 1 had a mode of 5. All problems described by the questionnaire items had occurred for some of the respondents and the percentage of respondents giving a rating above 1 for each item is shown in Table 6.

Table 5. Lowest and highest mean for any item in each age group.

Age	Lowest Mean	Item(s)	Highest Mean	Item(s)
5	1.10	30, 31	3.80	1
6	1.12	30	3.85	1
7	1.07	30	4.11	1
8	1.06	30	3.56	1
9	1.06	30	3.64	1
10	1.00	30	3.91	1
11	1.04	30	2.96	1
12	1.00	30, 32, 34	3.22	1

Factor Analysis

Factor analyses, both principal components and principal axis analyses, using orthogonal and oblique (direct oblimin) rotations were tested on the data. The components extracted remained essentially unchanged in these various analyses. In the oblique rotation the correlations between factors was low to moderate (highest being -.482), therefore the orthogonal solution was preferred. Following the advice of Gorsuch (1990) and Widaman (1993), that principal axis analysis is the preferred method when the research seeks to characterize latent constructs in the data, and since there was virtually no difference between the principal component and principal axis analyses, the latter was accepted. After examination of the scree test and the eigenvalues (greater than one) six factors were extracted and together they explained 69.45% of the total variance. The first factor was the predominant factor and explained 46.86% of the total variance.

Table 6. Percentage of respondents giving a rating above 1 (never or almost never happens) for each questionnaire item.

Item	Percentage	Item	Percentage
1	87.2	18	45.1
2	62.4	19	33.6
3	81.4	20	59.3
4	76.7	21	57.1
5	56.6	22	58.8
6	58	23	53.5
7	36.7	24	49.6
8	67.7	25	16.4
9	56.2	26	26.5
10	50.9	27	15.5
11	35.4	28	57.1
12	56.6	29	26.5
13	54.9	30	4.9
14	55.3	31	14.2
15	66.4	32	21.2
16	61.9	33	49.6
17	68.6	34	15.0

The items with a loading of .5 on each factor are shown in Table 7 (see Appendix C for the full factor table). Where an item loaded above .5 on two factors the other factor is indicated in Table 7. Again, transforming the data did not change the factors which were extracted or the items which loaded on them and the untransformed data are reported.

An interpretation is suggested for each factor. Factor 1 was related to forgetfulness for activities and habitual routines/behaviour and so may have a strong procedural element. Factor 2 was related to verbal memory, in particular word finding. The item which referred to failure to recognize did not appear to fit this factor, however it could be that the parent in observing the child had been unable to differentiate between failure to recognize as opposed to failure to retrieve the name. Factor 3 referred to expressive language and factor 4 to receptive language. Factor 5 was the least satisfactory factor with only two items. It is possible that both items were underpinned by language comprehension difficulties. Factor 6 was related to memory for visuo-spatial orientation.

Additional analyses extracting fewer factors were also tried. Four and five factor solutions did not remove factor 5 and only item 25 loaded above .5 in those solutions. A three factor solution left the first component unchanged. The two verbal factors were combined into one, and may have lost some interpretive power. The third factor was unclear as it combined factors 2, 5 & 6 from the 6 factor solution above.

Reliability

The test-retest reliability (stability) of the questionnaire was good with the correlation between the questionnaire on the two occasions $r_s = .916$ ($p<.01$). Internal reliability (consistency) was high with Cronbach's alpha = .9642.

Table 7. Factors with items loading above .5 in the 6 factor solution.

Factors and Items	Factor Loadings
Factor 1: Memory for activities	
Forgets where put something	.75
Forgets where things kept	.74
Loses things	.81
Forgets to take things with him/her	.79
Forgets routine things	.63
Forgets change in routine	.64
Does routine things twice by mistake	.57
Forgets to do things planned to do	.56
Go back and check what meant to do	.64
Starts to do something then forgets what was doing	.58
Forgets what s/he did yesterday or a few days ago, or gets details confused	.51
Factor 2: Word finding	
Forgets names of common things (also Factor 5)	.52
Forgets names of friends etc knows well	.57
Forgets name of someone met recently	.7
Fails to recognize someone met recently	.6
Factor 3: Expressive language	
Repeats something just said	.6
Forgets something just said	.68
Rambles	.58
Tip of tongue (also Factor 2)	.57
Joke retell	.48
Factor 4: Receptive Language	
Forgets what told few minutes ago (also Factor 1)	.58
Forgets what told a few days ago (also Factor 1)	.69
Forgets message	.59
Details told confused	.59
Factor 5: Language Difficulty	
TV difficult to follow	.77
Forgets names of common things (also Factor 2)	.52
Factor 6: Visuo-spatial orientation	
Gets lost where often been before	.77
Gets lost where not often been before	.55
Doesn't recognize place often been before	.67

WRAML and WISC III subtests

Means for the subtests within each age group are shown in Table 8. For the delayed recall and recognition tests and trials 1 to 4 of the learning tests, age scaled scores were not available and so means were compiled from the raw data in each age group (see Appendix D for all subtest means including learning trials). In the tests which compiled means from raw scores within each age group the expected trend of improved performance from the youngest to oldest age group was observed (see Table 8).

Table 8. Mean scores on WRAML and WISC III subtests in each age group

WRAML subtests	Age groups					
	6 Years		8 years		10 years	
	M	(SD)	M	(SD)	M	(SD)
Verbal Learning Total	9.91	3.16	10.15	3.09	9.70	2.93
Verbal Learning Delay+	5.74	2.48	7.38	1.76	9.33	2.67
Story 1&2	8.41	2.63	8.53	3.75	8.45	3.43
Story 1&2 Delay +	12.47	7.06	19.59	8.63	19.94	9.68
Story Recognition +	10.35	2.51	11.24	2.56	10.70	2.32
Finger Windows	10.21	2.32	9.50	2.21	10.64	2.63
Visual Learning Total	10.06	2.93	9.47	2.96	10.58	3.25
Visual Learning Delay+	6.50	2.21	7.09	2.82	9.18	3.32
Number Letter	9.09	2.01	8.35	2.29	8.58	3.10
Vocabulary WISC	10.18	3.15	8.03	3.63	9.82	3.27
Block Design WISC	10.79	3.28	10.09	3.12	12.06	3.64
FSIQ WISC	103.26	15.81	94.53	17.33	105.42	16.47

+ Means compiled from age group raw scores.

There were no differences in those tests using age scaled scores: Verbal Learning immediate recall, Story Memory immediate recall, Finger Windows, Visual Learning immediate recall, Number Letter across the three age groups. There was a difference in FSIQ across the ages ($F(2,98) = 4.096$, $p < .05$). The eight years age group had the lowest FSIQ but Bonferroni comparisons showed this group to be different only to the 10 years age group ($p < .05$) however FSIQ did not correlate with questionnaire total in the 8 years age group (see below).

Correlations between the EMQ and WRAML subtests

Spearman correlations were computed between questionnaire total scores and WRAML subtests. Correlations between age scaled scores on WRAML subtests and questionnaire total scores combining all age groups are shown in Table 9 and none were significant. Note that in

Table 9. Correlations between standard scores on WRAML subtests and questionnaire total scores for all ages combined (6, 8 and 10 years)

WRAML subtest	Correlation coefficient
Verbal Learning	-.186
Story Memory	-.143
Finger Windows	-.024
Visual Learning	-.167
Number Letter	-.009
WISC Vocabulary	-.114
WISC Block Design	-.120
WISC FSIQ	-.158

correlations between the EMQ and WRAML subtests a higher questionnaire total signals more memory problems and a lower memory test score signals more memory problems leading to negative correlations.

Table 10 shows correlations between questionnaire total score and WRAML subtests according to age group (see Appendices E1, E2, E3 for all results including learning trials). Since there were few reliable correlations it was possible that this was due to developmental changes occurring within an age group. To assess this each age group was divided into two groups: 6.00 to 6.49 years and 6.50 - 6.99; 8.00 to 8.49 and 8.50 - 8.99; 10.00 to 10.49 and10.50 to 10.99 and correlations performed with the WRAML subtests which used age scaled scores. These analyses, however, did not alter the general pattern of results (see Appendices E1, E2, E3).

The data suggested that memory everyday memory was verbally mediated in the oldest age group as only verbal learning correlated with the questionnaire. In the youngest age group it was visual learning which correlated with the questionnaire suggesting a visual mediation of everyday memory in this age group. This pattern of verbal mediation of memory in the oldest age group and visual mediation in the youngest age group was supported by the intercorrelations of WRAML subtests. In the 10 years group verbal memory, either verbal learning or story memory correlated with all tests except Number Letter. The same verbal mediation was not seen in the younger groups with verbal and visual memory more independent of each other, especially in the 6 year old age group (see Appendices F1, F2, F3).

Table 10. Correlations between questionnaire total score and WRAML subtests in each age group

WRAML subtests	Age groups		
	6 years	8 years	10 years
Verbal Learning total	-.157	.019	-.456**
Verbal Learning Delay +	-.170	-.116	-.568**
Story Memory 1 & 2	-.147	.007	-.295
Story Memory Delayed recall +	-.113	-.080	-.301
Story Memory Delayed recognition +	-.060	-.098	-.238
Finger Windows	.020	.189	-.161
Visual Learning total	-.350*	.047	-.181
Visual Learning Delay +	-.364*	.047	-.212
Number Letter	.048	-.166	-.042
WISC Vocabulary	-.054	-.038	-.241
WISC Block Design	-.115	.263	-.466**
WISC FSIQ	-.194	.100	-.405*

* Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)
+ Means were compiled from the appropriate group's (school/clinic) raw scores.

Correlations between EMQ factors and WRAML subtests

The correlations between the EMQ total and WRAML subtests were generally low and it was possible that the correlation with the WRAML subtests could have been improved by using the factors from the questionnaire instead of the total overall score. The scores from the items comprising each factor were summed and then correlated with the WRAML subtests. However, this did not improve correlations between the questionnaire and WRAML subtests (see Appendix G).

Clinical data

The mean score for the total clinic questionnaire (30 items, 5 ratings categories) was 68.23 (SD 20.06) ranging from 36 to 105. The highest mean score was 3.66 for item 14 (Forgets what s/he was told a few minutes ago) and the lowest was 1.23 for item 34 (Does not recognize places s/he has often been to before).

The means of the total questionnaire in each diagnostic category are shown in Table 11. A Kruskal-Wallis test showed no differences among the different diagnostic categories on their total questionnaire score (X^2 (3) = 1.970 (p >.05).

Table 11. Means of questionnaire totals in each diagnostic category.

Diagnosis	M	(SD)
Learning Disorder (reading or spelling)	66.25	18.50
Learning Disorder(reading or spelling + arithmetic)	64.31	21.24
ADHD	66.00	16.97
Learning Disorder + ADHD (reading and/or spelling)	74.17	21.16

Means compiled from WRAML age scaled scores or raw scores for the clinic group (diagnostic subgroups combined) are shown in Table 12 along with those from the school group with all ages combined. A series of *t* tests with Bonferroni correction was used to assess any differences between groups on memory tests, including the learning trials. A significant difference was found only between Number Letter in the two groups ($t_{(.025)}$ (134) = - 5.147, p < .01). See Appendix H for all subtest means including the learning trials.

Table 12. Mean scores for WRAML and WISC III subtests in the clinic group and the school group with all ages combined

WRAML subtest	Clinic Group		School Group	
	M	(SD)	M	(SD)
Verbal Learning Total	9.54	2.80	9.92	3.04
Verbal Learning Delay +	6.91	2.69	7.47	2.74
Finger Windows	9.58	2.69	10.11	2.41
Visual Learning Total	9.68	2.96	10.03	3.05
Visual Learning Delay +	7.53	2.88	7.57	3.01
Number Letter	6.31**	1.78	8.67**	2.5
WISC III VIQ	94.53	14.95	-	-
WISC III PIQ	96.19	12.59	-	-
WISC III FSIQ	95.28	11.80	101.03	17.05

** Difference is significant at the .01 level (2-tailed)
+ Means were compiled from the appropriate group's (school/clinic) raw scores.

Spearman correlations were computed between questionnaire total scores and WRAML scores for the clinic group combining all ages and are shown in Table 13. Similarly to the school group when all ages were combined, correlations were moderate to low and none were reliable. See Appendix I for correlations with all subtests including learning trials.

Table 13. Correlations between scores on WRAML subtests and questionnaire total scores.

WRAML subtest	Correlation coefficient
Verbal Learning Total	.063
Verbal Learning Delay +	.152
Finger Windows	-.062
Visual Learning Total	-.092
Visual Learning Delay +	.231
Number Letter	-.261
WISC III VIQ	-.076
WISC III PIQ	-.148
WISC III FSIQ	-.080

+ Mean compiled from age group raw scores.

Comparison between the EMQ in school and clinic groups

In the school group the mean for the total of the reduced questionnaire (30 items, 5 ratings categories), combining all ages, was 48.43 (SD 15.84), ranging from 29 to 124. A Kruskal-Wallis test showed a significant difference between the mean total questionnaire scores for the school and clinic groups ($X^2 = 32.648$, $p < .01$). Twenty one of the twenty nine questionnaire items were significantly different between the two groups and there was reasonable agreement between groups on what were common or rare memory failures (see Table 14).

Table 14. Comparison of questionnaire items between school and clinic groups. Items are ranked from highest to lowest means in respective groups.

Rank	Questionnaire item		Rank	Questionnaire item	
	School group	Clinic group		School group	Clinic group
1	1**	14**	16	10**	10**
2	3**	15**	17	18**	8
3	15**	21**	18	28**	19**
4	22**	1**	19	24	6
5	5**	22**	20	7	24
6	14**	17**	21	19**	11*
7	17**	16**	22	11*	26**
8	8	5**	23	26**	7
9	21**	3**	24	29	25**
10	16**	20**	25	32	27*
11	20**	28**	26	25**	29
12	6	18**	27	34	32
13	13**	23**	28	27*	31
14	9*	13**	29	31	34
15	23**	9*			

* Difference is significant at the .05 level
** Difference is significant at the .01 level

Test characteristics (diagnostic indicators)

The first stage in determining diagnostic indicators is to determine a cutoff on the test. The optimal cut off score between the school and clinic groups on the questionnaire was determined by DAG_stat (Mackinnon, 2000) and found to be 48. Using this cutoff, sensitivity, specificity and predictive power were determined by DAG-stat (see Tables 15 &

16). From Table 15 it can be seen that 31/35 of the clinic group scored above the cutoff score and therefore were accurately identified by the questionnaire giving the questionnaire a sensitivity of 89%. From Table 15 it can be seen that 136/226 of the school group scored below the cutoff score and were accurately identified giving a specificity of 60%. This left a rather large proportion (90/226) of the school group inaccurately identified by the questionnaire as having a disorder.

The predictive power of a test takes into account false positives (when the test inaccurately identifies an individual as having the diagnosis) and false negatives (when the test inaccurately identifies an individual as not having the diagnosis) as well as prevalence of the disorder. Positive predictive power (PPP) is the rate of true positives compared to all positives, and negative predictive power (NPP) is the rate of true negatives compared to all negatives (Baldessarini et al., 1983).

Table 15. Distribution of subjects by diagnosis and questionnaire total.

		Questionnaire		
		Positive	Negative	Total
Diagnosis	Positive	31	4	35
	Negative	90	136	226
	Total	121	140	261

Test characteristics (95% CI)
Sensitivity = 89% (73% - 97%)
Specificity = 60% (53% - 67%)
False positive rate = 40% (40% - 47%)
False negative rate = 11% (3% - 27%).

From Table 16 it can be seen that the questionnaire has poor PPP over a range of prevalence rates and would be over-inclusive, incorrectly classifying individuals who do not have a disorder as having one. The prevalence rate for this study was 13% and the PPP was 25%. The NPP of the test was high and at the prevalence rate for this study was 97%. These characteristics show that the questionnaire could be useful in confirming a negative diagnosis.

Table 16. Predictive power according to various prevalence rates.

Prevalence	Positive predictive power	Negative predictive power
2.5%	.05	1.00
5%	.1	.99
10%	.2	.98
13%	.25	.97
15%	.28	.97

DISCUSSION

Validation of the EMQ by factor analysis using data from the school group showed that its properties were generally consistent with theoretical conceptions of memory. The first factor was associated with memory for activities. It covered a range of items concerned with forgetting to do things, to take things with him/her and where things have been put, which are associated with procedural memory and habits. The second factor consisted of items relating to forgetting names and failing to recognize people. The third and fourth factors concerned memory associated with expressive and receptive language respectively. The fifth factor was the least satisfactory containing two items possibly related to language comprehension

difficulty, and the sixth factor was a visuo-spatial orientation factor.

The factors extracted from children's data here matched satisfactorily with factors extracted using adult data (Cornish, 2000; Richardson & Chan, 1995). There was good correspondence between the items of the expressive and receptive language factors described above and the expressive and receptive communication factors of Richardson & Chan (1995). Their other factors also corresponded well, with their face recognition factor matching the second factor above; route finding matched the visuo-spatial orientation factor; and their absent mindedness factor matched the first factor above, memory for activities. There was a reasonable correspondence with the results of Cornish (2000). He described a conversational monitoring factor which combined items from the expressive and receptive language/communication factors above and his spatial memory factor corresponded to the visuo-spatial orientation and route finding factors. Cornish (2000) also described a "memory for activities" factor which corresponded to the factor of the same name here and with the absent mindedness factor of Richardson & Chan (1995). However this was a smaller factor in Cornish (2000) with five items compared to thirteen items in the present study and twelve in Richardson & Chan (1995). The "retrieval" and "task monitoring" factors of Cornish (2000) fitted least well with the children's data here and the factors of Richardson & Chan (1995). Comparing the three studies, the best correspondence was observed between the children's data and Richardson & Chan's (1995) data and this may have been due to their use of both self and others' ratings whereas the Cornish (2000) study used only self ratings.

All the memory failures described by questionnaire items had occurred for some of the respondents in both the school and clinic groups at least occasionally. The mean total

questionnaire score was significantly different between the two groups, however there was considerable overlap between the two distributions. The majority (72%) of the individual questionnaire items were significantly different between the two groups. The items which did not discriminate between the groups were rated as occurring very infrequently and were items referring to forgetting a change in routine or doing a routine thing twice; forgetting plans; unknowingly retelling a joke; failing to recognize famous people or familiar places and getting lost in familiar places. Similarly, the items referring to mistakenly doing a routine thing twice, failing to recognize famous people and getting lost in familiar places did not discriminate in the studies by Sunderland and colleagues (Sunderland et al., 1983; Sunderland et al., 1984). The retelling of a joke did discriminate in adults however, and is probably an inappropriate item for children.

The performance of the school and clinic groups on the WRAML subtests generally fell within normals limits. The one exception was Number Letter in the clinic group which is a test associated with attention and working memory (Burton et al., 1996; Burton et al.,1999; Dewey et al., 1997; Goia, 1998). It was below normal limits in the clinic group and was significantly different to the school group. Both LD and ADHD children could be expected to perform poorly on such a test and this finding was consistent with previous research showing poorer performance on Number Letter in ADHD and LD children (Kaplan et al., 1998). According to previous research, differences were also expected on other WRAML subtests, including Finger Windows, however none were observed. The only memory test data available for comparison between the two groups, apart from Number Letter and Finger Windows, were from verbal and visual learning subtests in which material was presented over a number of learning trials and this repetition could have assisted learning and memory

performance in the clinic group raising it to comparable performance with the school group. However there were no differences between groups on any of the individual learning trials and so this was not a satisfactory explanation. The reasons for these findings are uncertain but they may be due to the small numbers in the clinic group which included ADHD and/or various types of LD.

The relationship of the EMQ with the WRAML subtests in the school group varied over the age ranges assessed and only the verbal and visual learning subtests showed any relationship with the EMQ. Factor analytic research has shown that these learning subtests do not form a separate learning scale but are related to verbal and visual memory (Burton et al., 1996; Burton et al.,1999; Dewey et al., 1997; Goia, 1998). In the 10 years age group there were reliable correlations, ranging from .39 to .61 with the EMQ and verbal learning total (immediate and delayed recall) and also with three of the four learning trials. This was consistent with the findings of Sunderland et al. (1983) who used the EMQ with head injured adult patients and an orthopaedic control group. The control group provided the most appropriate comparison for the school group and the EMQ ratings by the family members showed moderate but reliable correlations (.33 to .45) with immediate and delayed recall of two short stories, paired associates and a forced choice word recognition test.

In the 8 years age group correlations were low and none were reliable. In the 6 years age group there were few reliable correlations and only the visual learning immediate and delayed recall subtests demonstrated a moderate association with the EMQ. Considering the lack of correlation in the 8 year age group it is uncertain whether the correlation with visual memory in the 6 year age group is reliable. It may be spurious, in which case the data suggest that the

EMQ is not a reliable instrument for children below 10 years of age. However, the data are consistent with findings that younger children do not demonstrate the same verbal mediation of memory as older children and adults (Gathercole, 1998). The intercorrelations of the WRAML subtests across ages also showed this pattern with verbal memory tests correlating with visual memory tests in the 10 year olds but not in the 6 year olds. The lack of correlation between the EMQ and WRAML memory tests in the 8 year age group may perhaps be explained as due to this group's being in transition from less visual mediation of memory to more verbal mediation, with the result that correlation of the EMQ with either verbal or visual memory alone was not sufficiently strong to appear.

Correlations between WRAML memory tests and the EMQ in the clinic group were low and unreliable. This mirrored the results in the school group when all ages were combined. The correlation between formal testing and the EMQ appeared only when data were examined within each age group. There were insufficient numbers in the clinic group to subdivide them according to age.

The optimal cutoff score between the total EMQ score for both groups was the mean of the school group. Using this score the EMQ was found to have good sensitivity (89%) and so was able to correctly identify children in the clinic group, in most instances. The specificity was moderate to good (60%) and so the EMQ demonstrated reasonable ability to identify children in the school group, however there was a considerable proportion who were misclassified. At the prevalence rate for this study (13%) these characteristics gave the EMQ high NPP (97%) but poor PPP (25%). Due to this poor PPP the EMQ would not be a suitable diagnostic tool to identify children with the sorts of memory problems encountered in ADHD and LD children.

The high NPP indicates that the EMQ may have some utility in confirming a negative diagnosis.

The purpose of this study was to examine the validity of the Everyday Memory Questionnaire (Sunderland et al., 1983) as a diagnostic aid for memory deficits in children. There was a significant difference between the questionnaire mean total scores of the school and clinic groups, however calculation of predictive power indicators suggested that the EMQ was not a useful diagnostic aid for establishing a positive diagnosis, at least for the clinical group in this study. These results highlight the limitations of using only significance testing to establish the diagnostic validity of psychological tests. It must be acknowledged however, that the clinical sample used was small and possibly insufficiently representative to have provided a fair test of the diagnostic characteristics of the EMQ.

Correlations with formal memory tests and factor analysis, showed the EMQ to have similar properties in relation to children's memory as found with adult memory. These results suggest that, to the extent that the EMQ reflects everyday memory in adults, it also reflects everyday memory in children, at least as young as 10 years of age. It could therefore be useful to guide and monitor rehabilitation. Although the diagnostic utility of the EMQ with ADHD and LD children was shown to be limited in the present study, its utility in other clinical groups such as brain injury groups is not known and would need to be established in further research.

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Appendix A. Children's Memory Questionnaire

Children's Memory Questionnaire

This questionnaire seeks knowledge about children's memory. We would be grateful if you would agree to take part in our study by answering all questions and returning the questionnaire to your child's school.

Child's age:_____(month)_____(year)
Child's gender: male, female (circle appropriate one)

Below is a list of problems children might experience with memory. Please rate how often your child experiences these problems by circling the number for the description that best matches your child.

1 = Never or almost never happens; **2** = Occasionally happens; **3** = Happens once or twice a week; **4** = Happens about once a day; **5** = Happens more than once a day; **6** = about once a day; **7** = more than once a day

1. Forgets where she/he has put something.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. Forgets where things are usually kept or looks for them in the wrong place.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. Loses things.							
4. Forgets to take things with him/her or leaves things behind and has to go back for them.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. Forgets to do a routine thing which they would normally do once or twice a day.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6. Forgets a *change* in the daily routine, such as a change in the place where something is kept, or in the time something happens.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7. Does some routine thing twice or more by mistake.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8. Forgets to do things she/he said she/he would or arranged to do.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9. Has to go back to check whether she/he has done something she/he meant to do.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. Starts to do something, then seems to forget what it was she/he wanted to do.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. Slow to pick up a new skill such as a game or working some new gadget.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12. Forgets when it was that something happened e.g. whether it was yesterday or last week.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13. Forgets what she/he did yesterday or a few days ago, or gets the details of what happened mixed up and confused.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14. Forgets what she/he was told a few minutes ago.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15. Forgets what she/he was told yesterday or a few days ago.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16. Forgets to tell someone something important such as passing on an important message.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17. Gets the details of what someone told him/her mixed up and confused.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18. Repeats something she/he has just said or says the same thing several times.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19. Seems to forget something she/he has just said.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
20. Starts to say something, then forgets what it was she/he wanted to say.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
21. Loses track of what someone is trying to tell him/her.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

22. Tends to "ramble" about unimportant or irrelevant things.	1	2	3	4	5	6	7
23. A word seems to be "on the tip of the tongue" but she/he cannot quite find it.	1	2	3	4	5	6	7
24. Unknowingly tells someone a story or joke she/he has told that person before.	1	2	3	4	5	6	7
25. Finds television shows or movies (suitable for their age) difficult to follow.	1	2	3	4	5	6	7
26. Forgets the names of common things or uses the wrong names for them.	1	2	3	4	5	6	7
27. Forgets the names of friends or relatives they know quite well or calls them the wrong name.	1	2	3	4	5	6	7
28. Forgets the name of someone she/he met for the first time recently.	1	2	3	4	5	6	7
29. Fails to recognize someone she/he met for the first time recently.	1	2	3	4	5	6	7
30. Fails to recognize by sight people e.g relatives or friends that she/he meets frequently.	1	2	3	4	5	6	7
31. Fails to recognize well known television characters or other famous people by sight.	1	2	3	4	5	6	7
32. Gets lost or turns in the wrong direction in places she/he has often been to before.	1	2	3	4	5	6	7
33. Gets lost in places she/he has only been once or twice before.	1	2	3	4	5	6	7
34. Does not recognise places she/he has often been to before.	1	2	3	4	5	6	7

Adapted by Karen Drysdale and Wayne Levick (2001) from Sunderland, Harris & Baddeley (1983) and Sunderland, Harris & Gleave (1984)

We have tried to cover a wide range of memory problems but if there are aspects of children's memory which you have noticed, but we have not included in the questionnaire, we would like you to tell us about them, so please describe them below.

_____

_____

_____

_____

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_____

PLEASE PLACE THIS QUESTIONNAIRE IN THE ENVELOPE PROVIDED AND RETURN IT TO YOUR CHILD'S SCHOOL FOR COLLECTION BY RESEARCH PERSONNEL.

IF YOUR CHILD IS ALSO PARTICIPATING IN THE COGNITIVE ASSESSMENT PLEASE RETURN THIS QUESTIONNAIRE IN THE ENVELOPE WITH THE SIGNED CONSENT FORM.

Appendix B. Comparison of items from the school and clinic questionnaires with equivalent items from Sunderland et al., (1983) and Sunderland et al., (1984). (Any differences in the wording between the school and clinic questionnaires are shown.)

D = discriminated between normal and clinical groups; ND = did not discriminate.
F = floor item; A = additional item added in the Sunderland et al. (1984) study

Questionnaire item (school group)	Questionnaire item (clinic group)	Questionnaire item (Sunderland et al.,1983)	Questionnaire item (Sunderland et al., 1984)
1. Forgets where she/he has put something.(D)	15	18	1(D)
2. Forgets where things are usually kept or looks for them in the wrong place.	-	-	24(A)
3. Loses things.(D)	16	Combined with 18	Combined with 1
4. Forgets to take things with him/her or leaves things behind and has to go back for them.	-	-	7(A)
5. Forgets to do a routine thing which they would normally do once or twice a day. (D)	21	24	-
6. Forgets a *change* in the daily routine, such as a change in the place where something is kept, or in the time something happens. (ND)	29. Unable to cope with a change in their daily routine and follow the old routine by mistake.	34	4(D)
7. Does some routine thing twice or more by mistake. (ND)	22	25	26(F)
8. Forgets to do things she/he said she/he would or arranged to do.(ND)	30 Forgets to do things they had arranged to do.	35	14(A)

School questionnaire item	Clinic questionnaire item	Sunderland et al., (1983)	Sunderland et al., (1984)
9. Has to go back to check whether she/he has done something she/he meant to do. (D)	23	26	5(D)
10. Starts to do something, then seems to forget what it was she/he wanted to do. (D)	25	28	-
11. Slow to pick up a new skill such as a game or working some new gadget.(D)	28	33	12(D)
12. Forgets when it was that something happened e.g. whether it was yesterday or last week.	-	-	6(A)
13. Forgets what she/he did yesterday or a few days ago, or gets the details of what happened mixed up and confused. (D)	24. Forgets what they did yesterday or gets the details of what happened mixed up and confused.	27	15(D)
14. Forgets what she/he was told a few minutes ago.(D)	4	4	-
15. Forgets what she/he was told yesterday or a few days ago. (D)	5	5	8(D)
16. F to tell someone something important such as passing on an important message. (D)	11	11	18(D)
17. Gets the details of what someone told him/her mixed up and confused. (D)	12	12	20(D)
18. Repeats something she/he has just said or says the same thing several times. (D)	6 Repeats something they have just said or asks the same question several times.	6	27(D)

School questionnaire item	Clinic questionnaire item	Sunderland et al., (1983)	Sunderland et al., (1984)
19. Seems to forget something she/he has just said. (D)	7	7	16(D)
20. Starts to say something, then forgets what it was she/he wanted to say. (D)	9	9	-
21. Loses track of what someone is trying to tell him/her.(D)	8	8	-
22. Tends to "ramble" about unimportant or irrelevant things. (D)	10	10	10(D)
23. A word seems to be on the tip of the tongue but she/he cannot quite find it. (D)	3	3	13(D)
24. Unknowingly tells someone a story or joke she/he has told that person before.(ND)	13	13	21(D)
25. Finds television shows or movies (suitable for their age) difficult to follow. (D)	20 Finds television shows or movies difficult to follow.	23	3(F)
26. Forgets the names of common things or uses the wrong names for them. (D)	2	2	-
27. Forgets the names of friends or relatives they know quite well or calls them the wrong name. (D)	1	1	-
28. Forgets the name of someone she/he met for the first time recently. (D)	26 Unable to remember the name of someone they met for the first time recently.	30	-

School questionnaire item	Clinic questionnaire item	Sunderland et al., (1983)	Sunderland et al., (1984)
29. Fails to recognize someone she/he met for the first time recently. (ND)	27	31	-
30. Fails to recognize by sight people e.g. relative or friends that she/he meets frequently.	-	19	11(F)
31. Fails to recognize well known television characters or other famous people by sight. (ND)	17	20	23(F)
32. Gets lost or turns in the wrong direction in places she/he has often been to before. (ND)	18 Gets lost in places they have often been to before	21	25i(F)
33. Gets lost in places she/he has only been once or twice before.	-	32	25ii(D)
34. Does not recognize places she/he has often been to before. (ND)	19	22	2(D)

N.B. There is no Item 14 (Forgets the meanings of words) in the clinic questionnaire. This item was not used in the school questionnaire and so was ommitted from the clinic questionnaire for analyses in this study.

Appendix C. Factor Matrix (orthogonal rotation).

Questionnaire Items	Factors					
	1	2	3	4	5	6
1	.752	0.06698	9.915E-02	.176	-5.057E-03	.100
2	.738	.133	.191	.165	.160	.103
3	.808	.164	.192	.128	2.943E-02	8.192E-02
4	.793	.139	.117	.267	5.174E-02	2.861E-02
5	.625	.188	.269	.347	9.737E-02	9.732E-02
6	.644	.142	.201	.382	.199	.155
7	.561	.193	.223	.117	.414	9.929E-02
8	.563	.163	.341	.294	.121	2.071E-02
9	.638	.170	.344	7.164E-02	.185	.143
10	.582	.197	.309	.107	.227	.167
11	.337	.317	.297	.145	.444	.127
12	.466	.436	.262	.329	.192	.145
13	.511	.357	.280	.380	.189	.152
14	.549	7.347E-02	.232	.581	.147	.131
15	.556	.114	.193	.687	.186	8.428E-02
16	.361	.233	.300	.587	7.423E-02	2.234E-02
17	.368	.294	.364	.592	8.833E-02	7.246E-02
18	.304	.111	.596	.321	4.948E-03	7.452E-02
19	.277	.144	.684	.234	.263	.121
20	.440	.290	.474	.250	.273	.120
21	.443	.130	.412	.488	.322	8.439E-02
22	.399	6.672E-02	.583	.331	.121	.206
23	.287	.518	.571	.120	6.997E-02	7.218E-02
24	.406	.277	.479	7.055E-02	8.867E-02	.196
25	.162	.276	.137	.194	.769	.213
26	.272	.521	9.816E-02	.114	.520	.179
27	.182	.563	5.847E-02	.167	7.634E-02	8.781E-02
28	.202	.694	.199	.252	2.241E-02	.241
29	.147	.604	.117	9.170E-04	.197	.183
30	-8.250E-04	.373	2.319E-02	-2.686E-02	.232	.257
31	1.249E-02	.459	.200	.107	.312	.279
32	.272	.255	7.037E-02	3.997E-02	.314	.772
33	.138	.450	.160	.143	2.375E-02	.551
34	9.517E-02	.336	.156	7.500E-02	8.909E-02	.674

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 11 iterations.

Appendix D. Mean scores on WRAML and WISC III subtests in each age group.

WRAML subtests	Age groups					
	6 years		8 years		10 years	
	M	(SD)	M	(SD)	M	(SD)
Verbal Learning Trial 1 +	3.88	1.65	4.59	1.33	5.36	1.88
Verbal Learning Trial 2 +	5.12	2.04	5.74	1.97	7.36	2.42
Verbal Learning Trial 3 +	5.94	2.1	7	2.06	8.85	2.35
Verbal Learning Trial 4 +	6.62	2.53	8.03	2.68	9.82	2.66
Verbal Learning Total	9.91	3.16	10.15	3.09	9.7	2.93
Verbal Learnning Delay +	5.74	2.48	7.38	1.76	9.33	2.67
Story 1 +	7.15	4.31	10.47	4.21	11.76	4.15
Story 2 +	7.12	3.86	10.76	5.31	10.45	6.28
Story 1&2	8.41	2.63	8.53	3.75	8.45	3.43
Story 1&2 Delay +	12.47	7.06	19.59	8.63	19.94	9.68
Story Recognition +	10.35	2.51	11.24	2.56	10.7	2.32
Finger Windows	10.21	2.32	9.5	2.21	10.64	2.63
Visual Learning Trial 1 +	3.76	2.12	4.24	2.45	5.67	2.72
Visual Learning Trial 2 +	4.97	2.22	5.62	2.46	6.88	3.01
Visual Learning Trial 3 +	5.71	2.61	5.94	2.45	8.12	3.29
Visual Learning Trial 4 +	7.06	2.64	7.29	2.76	9.33	2.84
Visual Learning Total	10.06	2.93	9.47	2.96	10.58	3.25
Visual Learning Delay	6.5	2.21	7.09	2.82	9.18	3.32
Number Letter	9.09	2.01	8.35	2.29	8.58	3.1
WISC III Vocabulary	10.18	3.15	8.03	3.63	9.82	3.27
WISC III Block Design	10.79	3.28	10.09	3.12	12.06	3.64
FSIQ (SS)	103.26	15.81	94.53	17.33	105.42	16.5

+ Means compiled from age group raw scores.

Appendix E.1. Correlations between questionnaire total score and WRAML subtests in 6 years age group.

WRAML subtests	Age groups		
	6 years	6 - 6.49 years	6.5 - 6.99 years
Verbal Learning Trial 1 +	-.458**	.	.
Verbal Learning Trial 2 +	-0.151	.	.
Verbal Learning Trial 3 +	-0.08	.	.
Verbal Learning Trial 4 +	-0.08	.	.
Verbal Learning total	-0.157	0.001	-0.158
Verbal Learning Delay +	-0.17	.	.
Story Memory 1 & 2	-0.147	-0.161	-0.039
Story Memory Delayed recall +	-0.113	.	.
Story Memory Delayed recognition +	-0.06	.	.
Finger Windows	0.02	0.063	0.08
Visual Learning Trial 1 +	-0.19	.	.
Visual Learning Trial 2 +	-0.136	.	.
Visual Learning Trial 3 +	-.458**	.	.
Visual Learning Trial 4 +	-0.258	.	.
Visual Learning total	-.350*	-0.492	-0.253
Visual Learning Delay +	-.364*	.	.
Number Letter	0.048	0.187	0.044
WISC Vocabulary	-0.05	.	.
WISC Block Design	-0.115	.	.
WISC FSIQ	-0.194	.	.

* Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)
+ Means compiled from age group raw scores.

Appendix E.2. Correlations between questionnaire total score and WRAML subtests in 8 years age group.

WRAML subtests	Age groups		
	8 years	8 - 8.49 years	8.5 - 8.99 years
Verbal Learning Trial 1	0.262	.	.
Verbal Learning Trial 2	0.057	.	.
Verbal Learning Trial 3	-0.136	.	.
Verbal Learning Trial 4	-0.04	.	.
Verbal Learning total	0.019	-0.232	0.236
Verbal Learning Delay	-0.116	.	.
Story Memory 1 & 2	0.01	-0.173	0.143
Story Memory Delayed recall	-0.08	.	.
Story Memory Delayed recognition	-0.1	.	.
Finger Windows	0.189	0.028	0.397
Visual Learning Trial 1	0.022	.	.
Visual Learning Trial 2	0.025	.	.
Visual Learning Trial 3	0.16	.	.
Visual Learning Trial 4	-0.06	.	.
Visual Learning total	0.047	-0.34	0.41
Visual Learning Delay	0.047	.	.
Number Letter	-0.116	-0.149	-0.077
WISC Vocabulary	-0.04	.	.
WISC Block Design	0.263	.	.
WISC FSIQ	0.1	.	.

* Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)
+ Means compiled from age group raw scores.

Appendix E.3. Correlations between questionnaire total score and WRAML subtests in 10 years age group.

WRAML subtests	Age groups		
	10 years	10 - 10.49 years	10.5 - 10.99 years
Verbal Learning Trial 1 +	0.08	.	.
Verbal Learning Trial 2 +	-.385*	.	.
Verbal Learning Trial 3 +	-.610**	.	.
Verbal Learning Trial 4 +	-.509**	.	.
Verbal Learning total	-.456**	-.480*	-0.553
Verbal Learning Delay +	-.568**	.	.
Story Memory 1 & 2	-0.295	-0.371	-0.287
Story Memory Delayed recall +	-0.301	.	.
Story Memory Delayed recognition +	-0.238	.	.
Finger Windows	-0.161	-0.084	-0.379
Visual Learning Trial 1 +	-0.107	.	.
Visual Learning Trial 2 +	-0.031	.	.
Visual Learning Trial 3 +	-0.253	.	.
Visual Learning Trial 4 +	-0.194	.	.
Visual Learning total	-0.181	-0.266	-0.032
Visual Learning Delay +	-0.212	.	.
Number Letter	-0.042	0.024	-0.362
WISC Vocabulary	-0.241	.	.
WISC Block Design	-.466**	.	.
WISC FSIQ	-.405*	.	.

* Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)
+ Means compiled from age group raw scores.

Appendix F.1 Correlations between WRAML subtests for 6 years age group.

	Verbal Learning	Verbal Learning Delay	Story Memory	Story Memory Delay	Finger Windows	Visual Learning	Visual Learning Delay	Number Letter
Verbal Learning		.775**	.576**	.539**	0.029	0.217	0.205	-0.049
Verbal Learning Delay			0.337	.489**	0.02	0.171	0.095	0.067
Story Memory				.803**	-0.066	0.17	0.169	0.251
Story Memory Delay					-0.033	0.079	-0.029	0.281
Finger Windows						-0.149	0.132	0.195
Visual Learning							.757**	-0.155
Visual Learning Delay								-0.148
Number Letter								

* Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)

Appendix F.2 Correlations between WRAML subtests for 8 years age group.

	Verbal Learning	Verbal Learning Delay	Story Memory	Story Memory Delay	Finger Windows	Visual Learning	Visual Learning Delay	Number Letter
Verbal Learning		.582**	0.259	0.297	0.179	0.202	0.285	-0.025
Verbal L Delay			.343*	.405*	0.179	0.336	.387*	0.057
Story Memory				.849**	.415*	0.287	0.182	0.31
Story Memory Delay					.481**	0.209	0.179	0.215
Finger Windows						-0.055	-0.081	.368*
Visual Learning							.767**	-0.267
Visual L Delay								-0.26
Number Letter								

* Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)

Appendix F.3. Correlations between WRAML subtests for 10 years age group

	Verbal Learning	Verbal Learning Delay	Story Memory	Story Memory Delay	Finger Windows	Visual Learning	Visual Learning Delay	Number Letter
Verbal Learning		.613**	.456**	.483**	.413*	.480**	0.332	0.165
Verbal L Delay			0.196	0.166	0.244	.434*	.435*	-0.153
Story Memory				.956**	-0.133	0.332	0.262	0.204
Story Memory Delay					-0.074	0.303	0.199	0.271
Finger Windows						0.026	-0.102	0.267
Visual Learning							.815**	0.126
Visual L Delay								0.064
Number Letter								

* Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)

Appendix G. Correlations between the factors and WRAML subtests for each age.

		Factors					
		1	2	3	4	5	6
6 years	Verbal Learning	-0.119	-0.05	-0.111	-0.213	-0.249	-0.17
	Verbal L Delay	-0.125	-0.02	-0.103	-0.238	-0.02	-0.14
	Story Memory	-0.111	-0.05	-0.206	-0.105	-0.197	-0.13
	Story Delay	-0.063	0.103	-0.236	-0.123	-0.07	-0.11
	Finger Windows	-0.078	0.16	0.101	0	0.273	0.262
	Visual Learning	-0.338	-.340*	-0.315	-.387*	-0.188	-0.18
	Visual L Delay	-.437**	-0.141	-0.185	-.339*	-0.08	0
	Number/Letter	0.148	0.05	-0.1	0.133	0.126	0.07
8 years	Verbal Learning	0	0.047	0.085	0.06	0.293	0.185
	Verbal L Delay	-0.203	0	0.042	-0.16	0.087	0.233
	Story Memory	0.044	-0.07	-0.09	0.083	-0.199	0.107
	Story Delay	-0.066	-0.03	-0.201	-0.04	-0.07	0.117
	Finger Windows	0.15	0.021	0.157	0.114	-0.04	0.07
	Visual Learning	0.039	-0.09	0.095	0.132	-0.105	0.135
	Visual L Delay	0.067	0.029	0.131	-0.01	0.067	0.117
	Number/Letter	-0.061	-0.258	-0.149	0.031	-0.237	-0.22
10 years	Verbal Learning	-.442**	-0.101	-.373*	-.360*	-0.127	-0.19
	Verbal L Delay	-.552**	-0.275	-.548**	-.527**	-0.313	-0.26
	Story Memory	-0.3	-.387*	-0.198	-0.268	-.542**	-0.14
	Story Delay	-0.29	-.442*	-0.267	-0.255	-.525**	-0.17
	Finger Windows	-0.174	0.135	-0.192	-0.103	-0.19	0.277
	Visual Learning	-0.224	0.016	-0.169	-0.08	-0.136	-0.16
	Visual L Delay	-0.242	-0.07	-0.187	-0.07	-0.231	-0.3
	Number/Letter	0.04	-0.2	-0.03	0.01	-0.04	-0.12

* Correlation is significant at the .05 level (2-tailed)

** Correlation is significant at the .01 level (2-tailed)

Appendix H. Mean scores on WRAML and WISC III subtests in the clinic group and the school group with all ages combined.

WRAML subtests	Clinic group		School group	
	M	(SD)	M	(SD)
Verbal Learning Trial 1 +	4.17	1.82	4.6	1.73
Verbal Learning Trial 2 +	6.29	2.23	6.06	2.33
Verbal Learning Trial 3 +	7.89	2.43	7.25	2.46
Verbal Learning Trial 4 +	8.86	2.57	8.14	2.91
Verbal Learning Total	9.54	2.8	9.92	3.04
Verbal Learning Delay +	6.91	2.69	7.47	2.74
Finger Windows	9.58	2.69	10.11	2.41
Visual Learning Trial 1 +	4.53	1.99	4.54	2.55
Visual Learning Trial 2 +	6.03	2.34	5.81	2.67
Visual Learning Trial 3 +	6.79	2.89	6.57	2.98
Visual Learning Trial 4 +	8.15	2.84	7.88	2.9
Visual Learning Total	9.68	2.96	10.03	3.05
Visual Learning Delay +	7.53	2.88	7.57	3.01
Number Letter	6.31**	1.78	8.67**	2.5
WISC III VIQ	94.53	14.95	-	-
WISC III PIQ	96.19	12.59	-	-
WISC III FSIQ	95.28	11.8	101.03	17.1

** Difference is significant at the .01 level (2-tailed)

+ Means compiled from the appropriate group (school/clinic) raw scores.

Appendix I. Correlations between scores on WRAML subtests and questionnaire total scores in the clinical group.

WRAML subtests	
Verbal Learning Trial 1 +	0.25
Verbal Learning Trial 2 +	0.09
Verbal Learning Trial 3 +	0.12
Verbal Learning Trial 4 +	0.166
Verbal Learning Total	0.063
Verbal Learning Delay +	0.152
Finger Windows	-0.062
Visual Learning Trial 1 +	0.059
Visual Learning Trial 2 +	-0.205
Visual Learning Trial 3 +	-0.011
Visual Learning Trial 4+	0.03
Visual Learning Total	-0.092
Visual Learning Delay	0.231
Number Letter	-0.261
WISC III VIQ	-0.076
WISC III PIQ	-0.148
WISC III FSIQ	-0.08

+ Means were compiled from the appropriate group (school/clinic) raw scores.