LITERATURE REVIEW

Student Name:	**Karen Drysdale**
Student Number:	**76044696**
Degree:	**Master of Clinical Neuropsychology**
Research project:	**Development of a Children's Memory Questionnaire**
Supervisor:	**Associate Professor Arthur Shores**
Date of submission:	**2002**

Table of Contents

Theoretical Approaches to Memory

Memory has been viewed from various perspectives including structural and processing, and unitary or partitioned. Theoretical approaches to memory over recent decades have been strongly influenced by the model proposed by Atkinson and Shiffrin (1968), referred to as the "modal model". This model described a partitioned account of memory comprised of cognitive structures and processes. Different models and approaches to memory have been proposed since the modal model including computer based approaches such as parallel distributed processing (McClelland & Rumelhart, 1986; Rumelhart & McClelland, 1986). Despite these ideas, the conceptions exemplified by the modal model persist, particularly in the realm of clinical neuropsychological testing and assessment where the tests are based on these conceptions (for example the Wechlser Memory Scale III).

The structures of the "modal model" and their characteristics are well known. There are three storage systems: the sensory register, the short term store (STS) and the long term store (LTS). The sensory register has a large capacity but very brief duration, holding incoming sensory information from different modalities for periods of time usually less than one second. If information is not transferred to STS it decays quickly. STS is limited in both duration and capacity. It holds information for periods of time usually less than one minute (unless duration is increased by rehearsal) with a capacity of approximately 7 ± 2 items or chunks of information. LTS has both unlimited duration and capacity. Atkinson and Shiffrin (1971) commented that STS and LTS did need not to be conceived of being located in different places or structures in the brain and that STS could be viewed as the current activation of LTS.

Unlike these structural elements, other aspects of the model are now rarely associated with it. Control processes operating in the memory stores are among these. The control processes in STS include rehearsal, coding, organization, grouping and chunking. These processes are generally concerned with rendering material more memorable: rehearsal is the repetition of material to maintain its activation; coding refers to the modality of input and involves recoding of material, for example from visual to verbal format; organization encompasses many strategies and one example is arranging material according to semantic category. The process of rehearsal in the modal model has since been referred to as maintenance rehearsal to differentiate it from elaborative rehearsal (Craik & Lockhart, 1972). The latter is the association of incoming information with related concepts in long term memory. There is considerable overlap among these control processes, for example one means of organizing is chunking, and elaborative rehearsal can be associated with semantic organization. The control processes associated with LTS include those for STS which are involved with transfer of material from STS to LTS such as rehearsal and organization, and search strategies important for retrieval such as narrowing or directing the search of LTS according to category (semantic, phonemic and others) or temporal dimension (recent, distant).

STS and control processes are given a central role in this model and Atkinson and Shiffrin (1971) described these elements as a working memory under the immediate control of the individual involving attention and consciousness. Importantly, response is made from STS. The "verbal" nature of STS was emphasized but other STSs for other modalities were also mooted.

Consistent with these ideas emphasizing the control nature of a working memory, Baddeley and Hitch (1974) developed the STS component of the modal model preferring the term working memory. At the centre of the model they placed the central executive with various slave systems under its control which are associated with the various senses. The visuo-spatial sketchpad is associated with visual input and the phonological loop with auditory input, particularly of a language based nature. The phonological loop is comprised of a phonological store and an articulatory control process involved in recoding visual stimuli into a phonological code (where appropriate), and which refreshes information in the store by subvocal rehearsal. Baddeley (1997) described the phonological loop as supporting the development of language processes such as comprehension, learning to read and the acquisition of vocabulary.

The partitioning or fractionation of memory into primary and secondary systems such as short term and long term has been criticized (Crowder, 1982, 1989), however the fractionation has continued. Pertinent for clinical neuropsychology are the subdivisions of long term memory proposed by Tulving (1972, 1985). The first is episodic memory which deals with information relating to a specific episode e.g. where the car is parked. The second is semantic memory which deals with information of a general nature e.g. the capital of Australia. While such information was initially acquired in a specific episode, multiple reinforcement episodes have rendered the original episode unmemorable and indeed there may be no need to remember the the original episode as it may be unimportant. The third component is procedural memory, dealing with memory for skills and habits. Of these three types, it is episodic memory which is predominantly assessed in neuropsychological memory tests.

Another type of partitioning has continued in the various dichotomies proposed to explain memory such as declarative and nondeclarative (Squire, 1992), explicit and implicit (Jacoby & Witherspoon, 1982) which are described as memory with and without awareness. Continua may be more appropriate and indeed episodic and semantic memory may be better viewed as a continuum since all semantic memory must initially start as an episode. Even the dichotomy of verbal and visual memory dissolves when visual material is recoded into verbal format.

In cognitive psychology, memory is generally proposed to have three stages: encoding or acquisition, storage and retrieval. Encoding refers to incoming information into sensory systems; storage is the temporary or permanent record of memory in the short and long term systems; retrieval is the retrieving and utilization of memory. Information, even though successfully encoded and stored is subject to forgetting. There are two main accounts of forgetting. One is that information decays due to death of brain cells or degradation of network connections. The other proposes that forgetting is retrieval failure due to interference from other material in memory (Schwartz & Reisberg, 1991).

Executive function and memory

The control processes of the modal model appear to be among what are now referred to as executive functions. Executive functions are important for initiating, monitoring and maintaining behaviour and include functions sometimes referred to as hypothesis testing, planning, organization, response to changing contingencies, sequencing behaviour, self regulation, execution of response, volition, and many more (Damasio & Anderson,1993; Lezak, 1995). Working memory is closely associated with these functions, as it is the centre for managing incoming information, maintaining its activation, transferring information to LTS, retrieving from LTS, and controlling response.

Individuals with executive deficits may demonstrate memory deficits and this may be a direct consequence of disruption to the executive functions important for memory (the control processes of memory). Such individuals may also demonstrate problems with motivation and initiative and memory deficits are then an indirect consequence of this lack of motivation and initiative which adversely affects the implementation of the control processes (Stuss & Benson, 1984).

Neuroanatomy of memory

Neuroanatomical structure provides another perspective on memory and there are certain regions and structures in the brain which have been associated with the three stages of memory. The temporal lobes have an important role in memory. This was (in)famously established in humans by the resection of medial temporal lobes in epileptic patients, notably H.M., to control their epilepsy which resulted in dense amnesia (Scoville & Milner, 1957 cited in Gazzaniga, Ivry & Mangun, 1998). The temporal regions have usually been associated with the acquisition and storage of information, however more recent research has shown temporal regions to be involved in retrieval also (Nyberg & Cabeza, 2000) and considering that retrieval involves accessing stored information this is to be expected. The medial temporal lobes include the hippocampus, the amygdala, entorhinal and perirhinal cortices, and part of the parahippocampal gyrus (Squire, 1992; Tranel & Damasio, 1995). These areas are connected to association cortices in the temporal lobes which receive information from various sensory areas. Hippocampal structures are directly or indirectly connected to most of the brain and have a key role in the acquisition and consolidation of new learning (anterograde memory). Non-medial areas of the temporal lobes, parts of the anterior, inferior and lateral portions, are important for retrograde memory. The temporal lobe in the dominant hemisphere is involved with verbal memory and the non-dominant hemisphere temporal lobe is involved with non-verbal memory (Kolb & Wishaw, 1996; Tranel & Damasio, 1995).

The frontal lobes are also important for memory. The ventromedial region is well connected to other brain regions such as the sensory areas as well as the hippocampus and amygdala (the latter has an important role in emotional processing). This linkage of memory and emotion is related to past positive and negative reinforcement of behaviour, and so important for learning and maintaining an appropriate behavioural repertoire (Tranel & Damasio, 1995). Due to connections with the hippocampus this region has also been associated with retrieval from long term memory (Petrides, 1994). Left frontal regions have been found to be involved with semantic memory retrieval and right frontal regions with episodic memory retrieval (Markowitsch, 2000; Nyberg & Cabeza, 2000). The left prefrontal cortex has also been associated with encoding, regardless of the verbal or nonverbal character of the material (Fletcher, Shallice & Dolan, 1998; Fletcher, Shallice, Frith, Frackowiak & Dolan, 1998). Frontal regions including mid-dorsal and ventrolateral regions are involved with working memory (Petrides, 1994).

Other neuroanatomic regions important for memory include parts of the diencephalon such as the thalamus and mamillary bodies. The nature of their role is unclear, but they appear to support the medial temporal system. The basal ganglia and cerebellum are involved with procedural or motor memory (Tranel & Damasio, 1995). Parietal regions have also been implicated in memory, including working memory and retrieval (Nyberg & Cabeza, 2000).

Recent research has explored neuroanatomical aspects of memory in relation to the dichotomies mentioned above such as declarative and nondeclarative (Squire, 1992). More recent approaches describe memory as a distributed property of various cortical systems rather than by a structurally localized account (Nyberg & Cabeza, 2000). The important issue for clinical neuropsychology is that since neuroanatomical structures or systems involved with acquiring and encoding information, storing and retrieving it are widespread in the brain, memory is very vulnerable to brain insult.

Developmental aspects of memory

Two of the main conceptualizations of memory, structure and process, are reflected in two important ways memory develops. Neuroanatomically structural changes reflect neural development in myelination, dendritic arborisation, and synaptogenesis, and process changes reflect the development of control processes of memory such as rehearsal and encoding (Boyd, 1988; Cowan, 1997). Children's memory is viewed as being comprised of the same cognitive structures as adult memory, such as short term or working memory and long term memory (Gathercole, 1998). Young children's memory becomes more adult like by about 7 years of age (Gathercole,1998).

Bjorklund and Douglas (1997) point out that most research into the development of memory has concentrated on the development of strategies and their use. Strategies are effortful processes aimed at enhancing memory performance, are implemented deliberately, and develop. They can be equated with the control processes or executive functions involved with memory outlined above. Young children develop from being unable to use strategies even when instructed (mediation deficiency), to using them only when instructed (production deficiency) and eventually to spontaneous and appropriate use of strategies (Bjorklund & Douglas,1997). Of the three main stages of memory: encoding, storage and retrieval, strategies are implicated in all three.

Encoding strategies include rehearsal, coding, organization, and elaboration. Although the phonological store is thought to be present in young children (5-6 years) they do not spontaneously rehearse (subvocally) material to be remembered to the same extent as older children (10-11 years) and these age differences remain even when younger children are instructed to use rehearsal (Bjorklund & Douglas, 1997; Gathercole, 1998). The subvocal rehearsal process emerges about 7 years of age (Gathercole & Hitch,1993). Children's memory span increases from about 2 - 3 items at four years to about 6 items at 12 years and unlike adults, young children do not show a correlation between articulation rate and memory span, again suggesting that young children do not use rehearsal (Cowan et al., 1994; Gathercole, 1998). Although the immediate serial recall of children as young as 3-5 years is affected by word length, this is proposed to be due to word length in response rather than subvocal rehearsal (Gathercole, 1998).

Younger children do not recode visual stimuli into a phonological code as older children do

(Gathercole, 1998). With pictorial presentation younger children compared to older children are less impaired when memory items have labels of long articulatory duration or phonological similarity. Younger children appear to remember these items in terms of visual features and characteristics and show greater dependence on the visuo-spatial sketchpad than older children and adults in short term visual memory tasks. Younger children also show effects of perceptual featural similarity in memory tasks which older children do not (Hitch, Halliday, Schaafstal & Schraagen, 1988). Children show development in the visuo-spatial sketchpad over childhood including an increase in visual span. However it is thought that some of this development is due to the involvement of nonvisual strategies to mediate memory performance which increases over childhood, resulting in the memory of older children and adults being more verbally mediated than that of younger children (Gathercole, 1998).

Organization of material into semantic categories is another strategy and is not used spontaneously or effectively until 10 or 11 years of age. Similarly, young children can use elaboration when instructed, but they are less effective in using this (Bjorkland & Douglas, 1997). Younger children are less able to organize retrieval strategies than older children and younger ones benefit more from retrieval cues. Retrieval deficits in young children appear to be due to greater requirement for more specific links between encoding and retrieval contexts than older children, that is they need more cues/items from the original encoding to be reinstated to assist recall (Bjorkland & Douglas, 1997).

The development of memory strategies over childhood is due to various factors, including more experience of which strategies are useful, the ability to implement the strategy, the ablity to use it with little effort, and the ability to use better versions of the strategy (Bjorklund & Douglas, 1997; Cowan, 1997). Pertinent here is the association of strategies with executive function and the development of the frontal systems which continues into adolescence (Fuster, 1997). Another important factor in the development of strategies is mental resource, with strategy use being more effortful and requiring more resources in younger children. Greater resource economy is achieved with practice and experience (Guttentag, 1997) and when dealing with familiar material. For example experts perform better on memory tasks related to their expertise as they have greater background knowledge than novices (Bjorklund & Douglas, 1997). As knowledge increases with age, children can more efficiently and economically implement strategies for encoding and retrieval.

Memory deficits in children

Memory problems in adults can create difficulties in coping with everyday life ranging from mild "nuisance" level to severe disruption of the patient's and often the family's lives. In children there is also a range of deficit and associated problems. However in children, memory deficit can have a different type of repercussion due to the child's developmental status. Learning and memory are intimately linked and disruption to memory will inevitably mean an ensuing disruption in learning. The disruption in adults is generally of an anterograde nature i.e. consolidated learning and memory remains completely or largely intact and their problems are with acquiring new learning and memory. Children do not have an adult level of consolidated learning and memory and therefore disruption to this acquisition can lead to more fundamental deficits. 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.

The widespread nature of memory networks and systems was outlined above and it was noted that an implication of this is the vulnerability of memory to brain insult. Children experience memory deficits across all aspects of memory function resulting from various acquired brain insults as observed in adults e.g. brain injury 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), and insulin dependent diabetes (Hershey, Craft, Bhargava & White, 1997). Additionally there are other problems, present in the child from birth and which are now known or suspected to affect cognitive functions such as memory. These include 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 for LD and frontal regions for ADHD (Filipek, 1999).

There are various definitions of learning disorder encompassing various disabilities. A learning disorder may be defined as lower than expected achievement according to age, schooling and intelligence in reading, writing and arithmetic. Often included in the definition is the exclusion of other causes such as sensori-motor impairment and emotional disturbance. Prevalence rate is reported from approximately 2% - 10% (DSM-IV). Some researchers have observed that LD children vary along the two dimensions of verbal and nonverbal skills (Rourke & Tsatsanis, 1995). Considering the close link between learning and memory it is not surprising that memory deficits have been implicated in learning disorders.

Working memory, in particular the phonological loop, has been implicated in reading and writing (spelling) problems. LD readers have been found to have poor performance in digit span, the recall of strings of spoken words and sentences, and the pronunciation of nonsense words (Anderson & Gilandas, 1994; Gathercole & Baddeley,1989; Siegel & Ryan, 1989). Problems with the phonological loop could arise from the phonological store and/or the subvocal rehearsal process. Gathercole & Baddeley (1989) propose that the problem is the phonological store rather than the subvocal rehearsal process. Although it is short term or working memory that has received most attention in relation to LD, long term memory problems, verbal and non-verbal, recall and recognition, have also been found in children with learning disorders (Anderson & Gilandas, 1994; Kaplan, Dewey, Crawford & Fisher, 1998; Swanson, 1999).

Swanson (1999) points out that due to the intimate link of the central executive with working memory in Baddeley and Hitch's (1974) model, and the deficiency in working memory observed in LD, that executive problems could also be expected in LD. It is not surprising therefore to find LD being associated with attentional disorders such as ADHD and there is considerable debate concerning whether ADHD and LD are distinct disorders or different manifestations of the same syndrome (Johnson, Altmaier & Richman, 1999; Lazar & Frank, 1998).

Attention Deficit Hyperactivity Disorder (ADHD) is a disorder marked by inattention, impulsivity, distractibility and hyperactivity and has been recently divided into predominantly hyeractive-impulsive, predominantly inattentive and combined subtypes. Prevalence rates vary from 3% to 5% with males more often diagnosed than females (DSM-IV).

The close connection between executive function and memory was outlined above and so memory problems can be expected in ADHD. However Kaplan et al., (1998) comment that, although there is widespread acknowledgement of memory problems in ADHD, insufficient care has been taken to discriminate memory from executive problems. 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 and 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. They suggest that possibly ADHD should not be associated with memory deficit. However this appears to be a very limited view of memory as storage~~,~~ and suggests that memory and executive functions can be clearly demarcated. Denckla's (1996) commentary avoids this problem by differentiating between intentional and incidental learning in relation to memory. She points out that children with ADHD are good incidental learners (appropriate to their intellectual ability) as illustrated in incidental or "naturalistic" learning and that they can effortlessly and nonstrategically acquire, consolidate and retrieve. It is with the deliberate or intentional application of acquisition and retrieval processes that ADHD children have difficulties. In this respect it is more feasible to demarcate memory and executive processes.

Unlike the problems concerning long term memory problems in ADHD and consistent with the role of executive or memory control processes in working memory, deficits in working memory have been observed frequently in ADHD children (Barkley, 1997). Working memory is a key component in Barkley's (1997) model of ADHD, however rather than viewing working memory deficits as primary, he views them as being secondary to poor inhibitory control which does not permit sufficient time for working memory processes to effectively operate. Again this assumes the possibility of a clear demaraction between executive and memory functions.

Measurement of memory

Neuropsychological assessment of memory is conducted to assess level of memory function in an individual to determine if a deficit exists, and if so to determine the nature of the deficit (e.g. verbal/nonverbal; encoding/storage/retrieval). The information acquired from this measurement can be used for a variety of reasons including managing everyday living, return to employment, guiding rehabilitation, and guiding educational remediation in children.

Formal memory testing

Memory is typically measured by neuropsychologists using formal memory batteries and tests such as the Wechlser Memory Scales, The Wide Range Assessment of Memory and Learning, the Rey Auditory Verbal Learning Test and the Rey Complex Figure Test. These tests generally assess short term or working memory and episodic memory in verbal and nonverbal modalities, tested at immediate and delayed intervals using free and cued recall, and recognition.

Wide Range Assessment of Memory and Learning (Sheslow & Adams, 1990)

The Wide RangeAssessment of Memory and Learning (WRAML) was developed for children 5 - 17 years of age, and comprises two versions, one for children 5-8 years and the other for children 9-17 years. The version for younger children uses a reduced number of items, different starting points, modified stimuli and instructions. The WRAML consists of nine subtests grouped into three clinical scales: the verbal memory scale (Number/Letter, Sentence Memory, Story Memory); the visual memory scale (Finger Windows, Design Memory, Picture Memory); and the Learning scale which assesses learning over trials (Verbal Learning, Visual Learning, Sound Symbol). The WRAML employs cued/free recall and recognition which is assessed immediately after presentation or after a delay. Some tests require rote learning of discrete information while others use more complex and meaningful stimuli. The authors note that tests of a rote nature such as Number/Letter and Finger Windows may be sensitive to attentional problems.

Some researchers have challenged the validity of the scale structure of the WRAML. Generally they have found three factors, two of which may or may not be related to verbal and visual memory, and a third consistently related to attention. However they have found no evidence of a distinct learning scale. Gioia (1998) examined the factor structure using the standardization sample for WRAML development. In 5-8 year olds a three factor solution was produce with a general memory factor of Picture Memory, Design Memory, Verbal Learning, Story Memory and Sound Symbol; a verbal span factor of Sentence Memory and Number/Letter Memory; and a visual memory factor of Design Memory, Finger Windows and Visual Learning. A second-order analysis produced the General Memory factor again with each subtest having a significant loading. The second factor remained unchanged and the third factor included only Visual Learning.

For the 9-17 year olds the three factor solution presented a general learning and memory factor comprised of seven subtests across verbal and visual, memory and learning types; a second factor with the Sentence Memory and Number/Letter Memory dyad again and the third factor with Verbal Learning and Story Memory. The second order analysis produced a general memory factor again with all subtests loading on this factor. Another factor concerned visual memory with Picture Memory, Design Memory and Visual Learning. Sentence memory and Number/Letter memory again formed a separate factor and a final factor was defined by Story Memory alone.

There was no consistency across the two age ranges concerning first order verbal or visual memory factors, however the verbal span factor was the most robust across all analyses and age groups. This factor is what other researchers have referred to as an attentional factor. Aylward, Gioia, Verhulst and Bell (1995) have also confirmed a similar three factor solution in a clinical population of children referred for problems with school performance.

Burton, Donders, and Mittenberg (1996) conducted a structural equation analysis of the

WRAML standardization sample and tested various combinations of Verbal Memory, Nonverbal Memory, General Memory, Learning, Attention. They supported a three factor model in both age groups with the nonverbal factor including Finger Windows, Design Memory, Picture Memory and Visual Learning; a verbal factor of Story Memory, Verbal Learning and Sound Symbol; and an attentional factor of Number/Letter, Sentence Memory and also Finger Windows, although the coefficient was much lower in the latter compared to the former two.

Burton, Mittenberg, Gold and Drabman (1999) conducted the same structural equation analysis in a clinical sample which included Learning Disability, Attention Deficit Disorder, traumatic brain injury and miscellaneous problems (Developmental disorder, behavioural emotional disorder and normals (4.8%)) and confirmed the findings of Burton et al. (1996).

Dewey, Kaplan, and Crawford (1997) found a three factor structure in the WRAML using ADHD or LD (reading disabilities) children and normal children. They found that an attention factor consisting of Number Letter and Sentence Memory, was consistent across the three groups of children. The other two factors were less clearly differentiated, especially in the control group, but could be approximately interpreted as verbal and visual memory in the clinical groups.

Sheslow and Adams (1990) report that they arranged their three scales according to theoretical and to some extent, statistical considerations. The latter did not always support the theoretical considerations e.g. they found that Story Memory loaded more on the learning index than verbal memory but despite this kept the indices as they had hypothesized them. An examination of their factor tables reveals support for the findings of other researchers. The highest loading subtests on the “verbal” index are Sentence Memory and Number/Letter in both age groups and the learning index is more related to verbal/auditory processes. The visual index is related to visual memory and includes visual learning with a higher loading on this index than on the learning index (especially in the younger age group).

Problems with formal memory testing

There are problems associated with formal memory testing. One aspect of these problems concerns factors affecting the performance of the individual such as lack of motivation, depression, test anxiety, and secondary gains issues such as may occur with medico-legal assessment. Furthermore, in formal testing, memory performance is sampled on only the one or two days of assessment.

Another aspect concerns the tests. There may be problems with the limited range of memory functions that tests address, for example, relatively short delays to assess delayed memory, concentration on episodic memory tasks. Additionally there may be problems with the design of memory tests arising from limitations in theoretical knowledge about memory and problems with psychometric properties such as reliability and validity.

Reliability and Validity

Reliability and validity are the two main criteria on which psychological measuring instruments are evaluated (Dawis, 1998). Reliability addresses some sources of variation in performance which are not due to true differences in individuals and the characteristics being tested. Sources of such error in measurement include how consistently the test items measure the characteristic (internal consistency) and the stability of the test on different occasions (retest reliability or stability) (Anastasi, 1988).

Validity is generally divided into content, construct, and criterion validities. Content validity is the most primitive and depends largely on the judgement of experts whether the test taps a particular domain (Retzlaff & Gilbertini, 1994). This can be supplemented by empirical means (Anastasi, 1988). For example in the design of a memory questionnaire, a pilot study could ask individuals to list or rank their most common memory failures.

Construct validity is probably the most important aspect of validity (Clark & Watson, 1998) and it 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) and one source is the correlation with other similar tests. This can be used to assess the influence of similar or dissimilar constructs. Similar constructs should correlate, known as convergent validity, and dissimilar constructs should not correlate, known as discriminant validity. 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 (especially when the latter relies on relatively objective methods such neuroimaging). Two types are defined: predictive and concurrent which refer to differences in the timing between acquisition of test and criterion data (Anastasi, 1988). Comparison of a new test with an exisiting test is also referred to as criterion validity.

These types of validity are not exclusive, indeed construct validity is a comprehensive concept which encompasses the others (Anastasi, 1988). Messick (1998) 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.

Operating characteristics can be used in establishing predictive validity and are paralleled by signal detection theory. Operating characteristics are useful to assess the validity of a test in neuropsychology when the validity is a dichotomous decision placing a patient into groups such as disordered or normal (Retzlaff & Gilbertini, 1994). These characteristics are sensitivity, specificity and the predictive power of the test.

The first stage in determining these characteristics is to determine a cutoff on the test by testing it with a diagnosed clinical group and a control group. A test's sensitivity and specificity can then be determined. 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, which is the probability that a test accurately identifies an individual as not having the disorder, for example the proportion below the cutoff score (Baldessarini, Finkelstein, & Arana, 1983).

These characteristics are established in groups where the diagnostic status is known but a test must also be able to categorize appropriately in circumstances where the diagnosis is not yet known. This is refered to as the predictive power of the test, and must take 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). The prevalence of the condition is also taken into account and 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. 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 is another validity term used in reference to memory testing. This is ecological validity and it is related to external validity (Cook & Campbell, 1979). Ecological validity refers to the relationship between memory performance in experimental or formal testing situations and memory performance in everyday life and the ability of the the formal test to predict everyday (or behavioural) memory performance. Neisser (1978) and others have questioned the ecological validity of memory testing and research. He comments that memory is better when it is intrinsic to everyday activities and recalls Bartlett's proposals (1932/1995) that humans have good memory for the gist of things but not for details, such as the verbatim form of a story, or word lists. This is a valid point but his ideas have led to a proliferation of memory "types" such as flashbulb memory, autobiographical memory, eyewitness testimony, prospective/retrospective memory and many more (e.g. Cohen, 1996). As Banaji and Crowder

(1989) argue this may be neither a fruitful nor efficient manner in which to study and understand the general principles of memory.

Nevertheless, as the emphasis of clinical neuropsychological assessment moves away from diagnosis, due to increasing neuroimaging technologies, to describing function and its implications for everyday life and rehabilitation, the demands for ecologically valid information increase. This can be achieved by the design of more ecologically valid neuropsychological tests, such as The Rivermead Behavioural Memory Test (RBMT), and/or the supplementation of traditional neuropsychological tests with more ecologically or behaviourally valid information such as questionnaires (Wilson, 1989a; Wilson, Cockburn & Baddeley, 1985).

Memory Questionnaires

Questionnaires can assess memory subjectively or objectively. Objective memory questionnaires require individuals to recall or recognise knowledge or events, and subjective memory questionnaires require individuals *to judge* how well they can recall and recognize knowledge or events and so are a type of opinion survey about memory (Herrmann, 1984). (Only the latter type will be the subject of this review and so the term memory questionnaire (MQ) refers only to this type.) MQs can address a wide range of memory phenomena, some not amenable to laboratory or 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 differing levels of motivation), memory with environmentally or personally enriched contextual cues; and skill or procedural memory. Questionnaires can be a useful tool in assessing memory for diagnostic purposes and/or rehabilitation purposes. MQs are usually associated with the notion of everyday memory as this is most pertinent for the individual in answering questions about their own memory (Berry, West & Dennehey, 1989; Bennett-Levy & Powell, 1980; Gilewski, Zelinski & Schaie, 1990; Herrmann & Neisser, 1978; Sunderland, Harris & Baddeley, 1983).

Validity of memory questionnaires

Morris (1984) addresses the validity of memory questionnaires and lists five stages necessary for accurate 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 validity of the questionnaire.

The level of knowledge people have about their own memory function is problematic (Herrmann, 1984). People who have memory deficits cannot remember all their memory failures and so will inaccurately assess their memory performance. This may be counteracted to some extent by some individuals being aware that their memory is poor, however other individuals may be unaware of their memory problems and disbelieve others' judgement. However people with normal memory function may not be good judges of their own memory performance (Herrmann, 1982) 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).

Some of these problems with questionnaires may be overcome or ameliorated by avoiding self rating instruments and using family members to rate an individual's memory (Herrmann,1982). This raises other problems however, as family members will not witness all occasions or aspects of memory failure.

When the validity of MQs is assessed by comparison with published memory tests it has varied from substantial to low. Hertzog et al.,(1989) comment that poor correlation between formal tests and MQs does not necessarily mean that these questionnaires are invalid. If formal memory testing is poorly related to the practical aspects of memory as Neisser (1978) has claimed, then a poor correlation between formal tests and questionnaires of everyday memory is to be expected. Nevertheless, it can be assumed that some correlation with formal tests is desirable to establish some connection with memory performance but it is difficult to judge what might be considered to be an appropriate correlation.

Another reason for poor correlation of formal memory tests with MQs is that in everyday living people can use various aids to memory such as diaries, shopping lists, recall cues from other people, and additionally may be protected from their memory problems by relatives. This assistance may mask the person's awareness of impaired memory performance and/or result in a poor predictive relationship between the results of formal tests and MQs (Sunderland, Harris & Baddeley, 1984).

While there are problems with establishing validity in MQs, retest reliability is usually good (Herrmann,1982,1984; Morris, 1984). Establishing retest reliability of formal memory tests is problematic if the same test materials are used on the retest occasion. Performance on the second occasion will be affected by practice effects, in particular memory for the materials previously presented. Since MQs ask about opinions of memory performance rather than directly test it, they may avoid some of these retesting problems and so can be valuable in monitoring memory over time.

The Everyday Memory Questionnaire

Sunderland, Harris and Baddeley (1983) developed an Eveyday Memory Questionnaire (EMQ). They used spouse or carer ratings to overcome some of the problems of self report. They chose items over a wide range of memory failures that subjects had the opportunity to make and which pilot work had shown were typical of the clinical population they used, head injury. Five categories of failure were covered: speech, reading and writing, faces and places, actions, and learning new things. Checklists were also to be completed every night for seven days in an attempt to overcome the problem of forgetting incidences of memory failure. There were two "patient" groups, head injured and orthopaedic, who completed formal memory testing as well as the questionnaire and checklists, allowing comparison between these types of memory measurement as well as determination of the questionnaire's ability to differentiate between the two patient groups. Questionnaire and checklist ratings from spouses and carers were compared with the relevant patient ratings. The EMQ was administered in an interview format. Two head injured groups were used, one with a mean of 11 weeks post injury and another 2-3 years postinjury. There were few effects for the more recently injured group and only the results from the 2-3 year postinjury group are discussed below. The reasons for few effects in the recently head injured group may be due to some of the problems with questionnaires listed above: the person must have the memory failure (or an opportunity to observe it), classify it as a failure etc. Additionally the issue of permanent deficits arising from head injury is a sensitive one and people may be inclined to overlook or diminish the importance and frequency of such deficits when initially observed.

The memory tests used for validation included face recognition; story memory with immediate and delayed recall (15 minutes); paired associate learning (immediate and delayed recall); forced choice word recognition task; a vocabulary test; and a semantic memory reaction time (RT) task (statements such as "U.S. presidents have wings" were rated for True/False and RT for this rating was recorded).

Sunderland et al. (1983) found that correlations between total score on the questionnaire and individual items were nearly all positive, and so used the total score as the index of memory failure. Zero was the modal score for the majority of questions but each of the items had occurred in some proportion of participants. The relatives' questionnaire total was significantly different between clinical and control groups as were the checklists. Patients' checklists were also different between groups but the questionnaires were not.

Correlations between the questionnaire total and results from the memory tests can be seen in Table 1. Correlation between memory tests and checklists was generally very low and are not reported. The reason for the poor correlation with checklists may be that they applied only to a seven day period, whereas ratings for the questionnaire were based on observations over much longer periods of time. From Table 1 it can be seen that while there was low validity between patient questionnaire ratings and test results, the validity improved with relatives' ratings. Further research has also validated the EMQ by comparison with formal testing. Stewart, Sunderland and Sluman (1996) used the EMQ20 (number of items reduced from the 35 of Sunderland et al. 1983) and found moderate correlations between RBMT and EMQ total for stroke patients (-.41) and their relatives (-.47). Sunderland, Stewart and Sluman (1996) found slightly higher correlations between relatives' ratings on the EMQ total and RMBT (.62) and Warrington's (1984) recognition memory test for words (-.51) but no correlation with

Table 1. Correlations between questionnaire total and results of memory tests in head injured and orthopaedic control groups.

Memory Test	HI Patients	HI Relatives	Control Patients	Control Relatives
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 correlations 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.)
* $p < .05$
** $p < .01$

recognition of faces (.06). Lincoln and Tinson (1989) found similar correlations with their stroke patients and relatives between the RMBT and EMQ totals (-.46 in both groups). They also compared EMQ totals 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). Koltai, Bowler and Shore (1996) compared the RMBT, Wechsler Memory Scale-Revised (WMS-R) and the EMQ in individuals exposed to toxic substances and found significant correlations between patient and relative ratings on the EMQ with WMS-R (.5) and RMBT (.6) There was no difference between the WMS-R and RBMT in predicting the total EMQ score.

Other research has also validated the EMQ by demonstrating differences between clinical and normal groups or clinical groups with severe or mild memory deficits using significance testing. For example Sunderland, Harris and Gleave (1984) found that a self-administered format of the EMQ (Sunderland et al., 1983 used interview format) discriminated between mildly and severely head injured groups; Sunderland et al., (1996) found differences between the EMQ ratings by relatives of stroke patients according to the patients' performance on formal memory tests (RBMT and Recognition Memory Test (Warrington,1984)); Richardson (1996) found differences in relatives' EMQ ratings of higher and lower functioning multiple sclerosis patients; and Tinson and Lincoln (1987) found differences in EMQ scores between stroke patients and orthopaedic controls. There are no studies (to the author's knowledge) which provides diagnostic indicators for the EMQ.

Factor analysis has also been used to validate the EMQ. Sunderland et al. 1984 conducted a principal component analysis. There was a strong first component which accounted for 60% of the variance in relatives of mild head injured patients and 39% in mildly head injured patients. The authors concluded that the questionnaire comprised a unitary, general factor underlying everyday memory.

Cornish (2000) commented that previous EMQ research had examined clinical groups and their memory problems and had not been concerned with the theoretical issues of memory. He used self-ratings from university students in a factor analysis to relate everyday memory phenomena to theoretical knowledge about memory. A five factor solution was accepted which explained 48.5% of variance. Correlations of factors with each other were low to moderate. The factors were retrieval, task monitoring, conversational monitoring, spatial memory, and memory for activities (see Table 2).

Richardson and 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, expressive communication (see Table 3).

Use of the Everyday Memory Questionnaire with children

Questionnaires and checklists about various aspects of children's behaviour are widely used and they may also be useful in assessing memory function. The Everyday Memory Questionnaire may be suitable for this purpose. It has been found to have reasonable correlation with formal memory tests, especially verbal memory, in adults. The items address a wide range of memory problems which children have the opportunity to make and which parents are likely to know about in relation to their children. The EMQ overcomes some of the problems of self rating as it has been found to be a suitable instrument for others to complete in relation to the patient/subject of the questionnaire. This may be of additional relevance with children considering their developmental status in ability to judge their own performance and especially in younger children to meet the literacy demands of the questionnaire. There is research evidence to suggest that the EMQ is particularly suited for use with others.

Table 2. Items comprising the five factors in the study by Cornish (2000).

Factor	Items
1. Retrieval	Forgotten: what you were told, important details of what you did the day before, when something happened, to do things planned, what you have just said; tip of tongue phenomenon
2. Task monitoring	Difficulty picking up new skill; performed some routine thing twice by mistake; unable to follow thread of a story; failed to recognize close friends, relatives or famous faces by sight; forgotten important details about yourself; started to read something already read without realizing; failed to recognize places often visited.
3. Conversational monitoring	Unknowingly repeated joke or story to same person; details confused of something told; forgotten to tell someone something important; ramble on about unimportant things
4. Spatial memory	Lost in place often visited; lost in place infrequently visited; forgotten details of things done regularly; forgotten where things are normally kept.
5. Memory for activities	Forgotten: where you have put things, a change in your daily routine, to take things with you; had to go back to check whether you had done something; found television stories difficult to follow.

Table 3. Items comprising the six factors in the study by Richardson and Chan (1995).

Factor	Items
1. Receptive communication	Forgetten: something told minutes/days ago, what you did yesterday; confusing or losing track of what someone tells you
2. Route finding	Fail to recognize places, gets lost on un/familiar journeys; unable to cope with changed routine; television stories difficult to follow
3. Absent mindedness	Forgetting: names of friends, common things, what you wanted to do/say, what you have just said, to do routine things, where you put something; doing something twice, having to double check; tip of tongue phenomenon
4. Face recognition	Fail to recognize: people just met, famous faces; unable to remember name of people just met
5. Expressive communication	Repeating: story/something already said; ramble on about unimportant things; unable to follow story; forget to pass on message

Schwartz and McMillan (1989) and Goldstein and Polkey (1992) compared the EMQ with another memory questionnaire, the Subjective Memory Questionnaire (SMQ) (Bennett-Levy & Powell, 1980). They found that the EMQ was better than the SMQ in differentiating between controls and clinical groups according to relative's ratings, although the SMQ was better with patients' ratings. The reason for this may be that the SMQ puts less demand on the rater than does the EMQ. In the SMQ many items require only a judgement of whether memory is bad, average, good etc. whereas in the EMQ all items require judgements of the frequency of occurrence such as "more than once a week", so that the latter requires recall of both the failure and its frequency. Additionally, the SMQ items are more specific than EMQ items. In the SMQ raters are asked how good their memory is for things such as birthdays, telephone numbers, lyrics of songs, names of streets, train or bus times, whereas the EMQ items are worded in more general terms referring to memory performance for the names of common things, recognizing friends, following conversations. The more explicit recall cues in the SMQ may assist those with poor memory but be a hindrance with others' ratings as the latter may be unable to remember specific instances but can report their general impressions formed over time.

To the author's knowledge the EMQ has not been assessed for use with children and indeed there are no similar questionnaires available for children. Such a questionnaire could be useful as a diagnostic aid or to provide information on memory performance useful for rehabilitaiton. It is therefore useful to examine the properties of the EMQ in relation to children's memory.

References

Anastasi, A., (1988). Psychological Testing. USA: Macmillan Publishing Company.

Aylward, G.; Gioia, G.; Verhulst S.; & Bell, S. (1995). Factor structure of the Wide Range Assessment of Memory and Learning in a clinical population. Journal of Psychoeducational Assessment, 13(2), 132-142.

Anderson, V., & Gilandas, L. (1994). Neuropsychological assessment of learning disability: Linking theoretical and clinical perspectives. In S. Touyz, D. Byrne, & A. Gilandas, (Eds.), Neuropsychology in Clinical Practice (pp.128 - 161), Sydney:Academic Press.

Atkinson, R., & Shiffrin, R. (1968). Human memory: A proposed system and its control processes. In K. W. Spence (Ed.), The Psychology of Learning and Motivation: Advances in Research and Theory (Vol. 2, pp.89-195). New York: Academic Press.

Atkinson, R., & Shiffrin, R. (1971). The control of short-term memory. Scientific American, 225, 82-90.

Baddeley, A. (1997). Human Memory. Theory and Practice. Hove, UK: Psychology Press.

Baddeley, A., & Hitch, G. (1974). Working memory. In G. Bower (Ed.), Recent Advances in Learning & Motivation (Vol. 8, pp. 47- 89). New York: Academic Press.

Baddeley, A., Wilson, B. & Watts, F. (1995). Handbook of Memory Disorders. Great Britain: John Wiley & Sons Ltd.

Baldessarini, R., Finklestein, S., & Arana, G. (1983). The predictive power of diagnostic tests and the effect of prevalence of illness. Archives of General Psychiatry, 40, 569 - 573.

Banaji, M., & Crowder, R. (1989). The bankruptcy of everyday memory. American Psychologist, 44(9), 1185-1193.

Barkley, R. (1997). Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. Psychological Bulletin, 121(1), 65-94.

Bartlett, F. (1932/1995). Remembering. A Study in Experimental and Social Psychology. USA: Cambridge University Press.

Bennett-Levy, J., & Powell, G. (1980). The subjective memory questionnaire (SMQ). An investigation into the self-reporting of "real-life" memory skills. British Journal of Social and Clinical Psychology, 19, 177-188.

Berry, J.; West, R.; & Dennehey, D. (1989). Reliability and validity of the Memory Self-Efficacy Questionnaire. Developmental Psychology, 25(5), 701-713.

Bjorkland, D. F., & Douglas, R. N. (1997). The development of meory strategies. In N. Cowan, & C. Hulme (Eds.), The Development of Memory in Childhood (pp.201 - 246). Hove UK: Psychology Press.

Boyd, T. (1988). Clinical assessment of memory in children: A developmental framework for practice. In M. Tramontana & S. Hooper (Eds.), Assessment Issues in Child Neuropsychology (pp. 177-204). NY: Plenum Press.

Burton, D., Donders, J. & Mittenberg, W. (1996). A structural equation analysis of the Wide Range Assessment of Memory and Learning in the standardization sample. Child Neuropsychology, 2(1), 39-47.

Burton, D., Mittenberg, W., Gold, S., & Drabman, R. (1999). A structural equation analysis of the Wide Range Assessment of Memory and Learning in a clinical sample. Child Neuropsychology, 5(1), 34-40.

Clark, L. A., & Watson, D. (1998). Constructing validity: Basic issues in objective scale development. In A. E. Kazdin (Ed.), Methodological Issus & Strategies in Clinical Research (2nd ed., pp. 215-239). Washington, DC: American Psychological Association.

Cohen, G. (1996). Memory in the Real World. Hove, UK:Psychology Press.

Cohen, N. & Squire, L. (1980). Preserved learning and retention of pattern analyzing skills in amnesia: Dissociaton of knowing how and knowing that. Science, 210, 207-210.

Cook, T. D., & Campbell, D. T. (1979). Quasi-Experimentation. Design and Analysis Issues for Field Settings. Boston: Houghton Mifflin.

Cowan, N. (1997). The development of working memory. In N. Cowan, & C. Hulme (Eds.), The Development of Memory in Childhood (pp.163 - 199). Hove UK: Psychology Press.

Cowan, N., Keller, T. A., Hulme, C., Roodenrys, S., McDougall, S., & Rack. J. (1994). Verbal memory span in children : Speech timing cues to the mechanisms underlying age and word length effects. Journal of Memory and Language, 33, 234 - 250.

Cornish, I. M. (2000). Factor structure of the Everyday Memory Questionnaire. British Journal of Psychology, 91, 427- 438.

Craik, F., & Lockhart, R. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning & Verbal Behavior, 11, 671-684.

Crowder, R. (1982). The demise of short-term memory. Acta Psychologica, 50, 291-323.

Crowder, R. (1989). Modularity and dissociations in memory systems. In H. L. Roediger, & F. I. M. Craik (Eds), Varieties of Memory and Consciousness (pp.271 -294). Hillsdale NJ: LEA.

Damasio, A., & Anderson, S. (1993). The frontal lobes. In K. Heilman, & E. Valenstein, (Eds), Clinical Neuropsychology (pp.409- 460). NY: Oxford University Press.

Dawis, R. (1998). Scale construction. In A. E. Kazdin (Ed.), Methodological Issus & Strategies in Clinical Research (2nd ed., pp.193 -213). Washington, DC: American Psychological Association.

Dewey, D., Kaplan, B., & Crawford, S. (1997). Factor structure of the WRAML in children with ADHD or reading disabilities: Further evidence of an attention/concentration factor. Developmental Neuropsychology, 13(4), 501-506.

Denckla, M. (1996). Biological correlates of learning and attention: what is relevant to learning disability and Attention-Deficit Hyperactivity Disorder. Developmental and Behavioral Pediatrics, 17(2), 114-119.

Donders, J. (1993). Memory functioning after traumatic brain injury in children. Brain Injury, 7, 431 - 437.

Filipek, P. (1999). Neuroimaging in the developmental disorders: The state of the science. Journal of Child Psychology and Psychiatry, 40(1), 113-128.

Fletcher, P., Shallice, T., & Dolan, R. (1998). The functional roles of prefrontal cortex in episodic memory. I Encoding. Brain, 121, 1239-1248.

Fletcher, P., Shallice, T., Frith, C., Frackowiak R., & Dolan, R. (1998). The functional roles of prefrontal cortex in episodic memory. II. Retrieval. Brain, 121, 1249-1256.

Fuster, F. (1997). The Prefrontal Cortex. USA: Lippincott-Raven.

Gathercole, S. E. (1998). The development of memory. Journal of Child Psychology and Psychiatry, 39(1), 3-27.

Gathercole, S. E., & Baddeley, A. (1989). Evaluation of the role of phonological STM in the development of vocabulary in children: A longitudinal study. Journal of Memory and Language, 28, 200-213.

Gathercole, S. E., & Hitch, G. J. (1993). Developmental changes in short-term memory: A revised working memory perspective. In A. Collins, S. E. Gathercole, M. A. Conway, & P. E. Morris (Eds.), Theories of Memory (pp. 189 - 210). Hove, U.K.: Erlbaum.

Gazzaniga, M., Ivry, R., & Mangun, G. (1998). Cognitive Neuroscience. The Biology of Mind (pp. 247 - 288). USA: W.W. Norton & Company.

Gilewski, M.; Zelinksi, E.; & Schaie, K. (1990).The Memory Functioning Questionnaire for assessment of memory complaints in adulthood and old age. Psychology & Aging, 5, 482-490.

Gioia, G. A. (1998). Re-examining the factor structure of the Wide Range Assessment of Memory and Learning: Implications for clinical interpretation. Assessment, 5(2), 127-139.

Goldstein, L., & Polkey, C. (1992). Everyday memory after unilateral temporal lobectomy or amygdalo-hippocampectomy. Cortex, 28, 189-201.

Gruneberg, M., Morris, P., & Sykes, R. (1978). Practical Aspects of Memory. Great Yarmouth: Academic Press.

Guttentag, R. (1997). Memory development and processing resources. In N. Cowan, & C. Hulme (Eds.), The Development of Memory in Childhood (pp. 247 - 274). Hove UK: Psychology Press.

Hershey, T., Bhargava, N., Sadler, M., White, N., & Craft, S. (1999). Conventional versus intensive diabetes therapy in children with type I diabetes - effects on memory and motor speed. Diabetes Care, 22, 1318-1324.

Herrmann, D. J. (1982). Know thy memory: The use of questionnaire to assess and study memory. Psychological Bulletin, 92(2), 434-452.

Herrmann, D. J. (1984) Questionnaires about memory. In J. E. Harris & P.E. Morris (Eds.), Everyday Memory Actions and Absent-Mindedness, (pp.133 - 151). London: Academic Press.

Herrmann, D. J., & Neisser, U. (1978). An inventory of everyday memory experiences. In M..M. Gruneberg, P.E. Morris, & R. N. Sykes (Eds.), Practical Aspects of Memory, (pp.35 -51). London: Academic Press.

Hertzog, C., Hultsch, D. F., & Dixon, R. A. (1989). Evidence for the convergent validity of two self-report metamemory questionnaires. Developmental Psychology, 25(5), 687-700.

Hitch, G. J., Halliday, M. S., Schaafstal, A. M., & Schraagen, J. M. C. (1988). Visual working memory in young children. Memory and Cognition, 16, 120-132.

Jacoby, L., & Witherspoon, D.(1982). Remembering without awareness. Canadian Journal of Psychology, 36, 300-324.

Jambaque, I., Dellatolas, G., Dulac, O., Ponsot, G., & Signoret, J. (1993). Verbal and visual memory impairment in children with epilepsy. Neuropsychologica, 31(12), 1321-1337.

Johnson, B., Altmaier, E., & Richman, L. (1999). Attention deficits and reading disabilities: Are immediate memory defects additive? Developmental Neuropsychology, 15(2), 213-226.

Joy, P., Roberts, C., North, K., & De Silva, M. (1995). Neuropsychological function and MRI abnormalities in neurofibromatosis type I. Developmental Medicine and Child Neurology, 37, 906 - 914.

Kaplan, B., Dewey, D., Crawford, S., & Fisher, G. (1998). Deficits in long-term memory are not characteristic of ADHD. Journal of Clinical and Experimental Neuropsychology, 20(4), 518-528.

Kerns, K. A., Don, A., Mateer, C. A., & Streissguth, A. P. (1997). Cognitive deficits in non-retarded adults with foetal alcohol syndrome. Journal of Learning Disabilities, 30, 685-693.

Kolb, B., & Whishaw, I. (1996). Fundamentals of Human Neuropsychology. USA: W.H. Freeman & Co.

Koltai, D., Bowler, R., & Shore, M. (1996). The Rivermead Behavioural Memory Test and

Wechsler Memory Scale-Revised: Relationship to everyday memory impairment. Assessment, 3(4), 443-448.

Lazar, J. Wayne, & Frank, Y. (1998). Frontal systems dysfunction in children with Attention-Deficit/Hyperactivity Disorder and Learning Disabilities. Journal of Neuropsychiatry, 10(2), 160-167.

Lezak, M. (1995). Neuropsychological Assessment (3rd ed.). NY: Oxford University Press.

Lincoln, N.; & Tinson, D. (1989). The relation between subjective and objective memory impairment after stroke. British Journal of Clinical Psychology, 28, 61-65.

Luciana, M., Lindeke, L., Georgieff, M., Mills, M., & Nelson, C. A. (1999). Neurobehavioural evidence for working-memory deficits in school-aged children with histories of prematurity. Developmental Medicine & Child Neurology, 41, 521-533.

Markowitsch, H. J. (2000). Neuroanatomy of memory. In E. Tulving, & F. I. M. Craik (Eds.), The Oxford Handbook of Memory (pp. 465 - 484). NY: Oxford University Press.

McClelland, J., & Rumelhart, D. (1986). Parallel Distributed Processing. Explorations in the Microstructure of Cognition. Volume 2: Psychological and Biological Models. USA: MIT.

McMillan, T. (1984). Investigation of everyday memory in normal subjects using the subjective memory questionnaire (SMQ). Cortex, 20, 33-347.

Messick, S. (1998). Validity of psychological assessment: validation of inferences from persons' responses and performances as scientific inquiry into score meaning. In A. E. Kazdin (Ed.), Methodological Issus & Strategies in Clinical Research (2nd ed., pp. 241 - 260). Washington, DC: American Psychological Association.

Morris, P. E. (1984) The validity of subjective reports on memory. In J. E. Harris & P.E. Morris (Eds.), Everyday Memory Actions and Absent-Mindedness (pp.153 - 172).

London: Academic Press.

Neisser, U. (1978). Memory: What are the important questions? In M..M. Gruneberg, P.E. Morris, & R. N. Sykes (Eds.), Practical Aspects of Memory, (pp.3 - 24). London: Academic Press.

Nyberg, L., & Cabeza, R. (2000). Brain imaging of memory. In E. Tulving, & F. I. M. Craik (Eds.), The Oxford Handbook of Memory (pp. 501 - 519). NY: Oxford University Press.

Petrides, M. (1994). Frontal lobes and working memory: evidence from investigations of the effects of cortical excisions in nonhuman primates. In F. Boller & J. Grafman (Eds.), Handbook of Neuropsychology (Vol. 9, pp. 59-82). Amsterdam: Elsevier Science.

Ponsford, J., Sloan, S., & Snow, P. (1995). Traumatic Brain Injury (pp. 295 - 325). Hove, U.K. : Lawrence Erlbaum.

Retzlaff, P., & Gilbertini, M. (1994). Neuropsychometric issues and problems. In R. Vanderploeg (Ed.), Clinician's Guide to Neuropsychological Assessment (pp. 185-209). Hillsdale NJ: LEA.

Richardson, J. (1996). Memory impairment in multiple sclerosis: Reports of patients and relatives. British Journal of Clinical Psychology, 35, 205-219.

Richardson, J., & Chan, R. (1995). The constituent structure of subjective memory questionnaires: Evidence from multiple sclerosis. Memory, 3(2), 187-200.

Ris, M., & Noll, R. (1994). Long-term neurobehavioural outcome in paediatric brain tumour patients: Review and methodological critique. Journal of Clinical and Experimental Neuropsychology, 16(1), 21- 42.

Rourke, B., & Tsatsanis, K. (1995). Memory disturbances in children with learning disabilities: A neuropsychological analysis of two academic achievement subtypes. In

A. Baddeley, B. Wilson & F. Watts (Eds.), Handbook of Memory Disorders (pp.501-531), New York : John Wiley & Sons.

Rumelhart, D., & McClelland, J. &. (1986). Parallel Distributed Processing. Explorations in the Microstructure of Cognition. Volume 1: Foundations. USA: MIT

Schwartz, B., & Reisberg, D. (1991). Learning and Memory. USA: W.W.Norton & Co.

Schwartz, A.F., & McMillan, T. M. (1989). Assessment of everyday memory after severe head injury. Cortex, 25, 665-671.

Sheslow, D., & Adams, W. (1990). Wide Range Assessment of Memory and Learning. Delaware:JASTAK Assessment Systems.

Siegal, L. S., & Ryan, E. G. (1989). The development of working memory in normally achieving and subtypes of learning disabled children. Child Development, 60, 973-980.

Squire, L. (1992). Memory and the hippocampus: A synthesis from findings with rats, monkeys, and humans. Psychological Review, 99(2), 195-231.

Spreen, O., Risser, A. H. & Edgell, D. (1995). Developmental Neuropsychology (pp.183 - 315).

Stewart, F., Sunderland, A., & Sluman, S. (1996). The nature and prevalence of memory disorder later after stroke. British Journal of Clinical Psychology, 35, 369-379.

Stuss, D., & Benson, D. (1984). Neuropsychological studies of the frontal lobes. Psychological Bulletin, 95(1), 3-28.

Sunderland, A., Harris, John, & Baddeley, A. (1983). Do laboratory tests predict everyday memory? A neuropsychological study. Journal of Verbal Learning and Verbal Behavior, 22, 341 - 357.

Sunderland, A., Harris, John, & Baddeley, A. (1984). Assessing everyday memory after severe head injury. In J. E. Harris & P. E. Morris (Eds.) Everyday Memory Actions and

Yeates, K. O., Enrile, B. G., Loss, N., & Blumenstein, E. (1995). Verbal learning and memory in children with myelomeningocele. Journal of Pediatric Psycholoigy, 20, 801- 815.