THE DEVELOPMENT OF A VISUAL PERCEPTION TEST FOR LEARNERS IN THE FOUNDATION PHASE

by

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I declare that **THE DEVELOPMENT OF A VISUAL PERCEPTION TEST FOR LEARNERS IN THE FOUNDATION PHASE** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Clutten

SYLVIA CATHERINE CLUTTEN

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DATE

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THE DEVELOPMENT OF A VISUAL PERCEPTION TEST FOR LEARNERS IN THE FOUNDATION PHASE

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SUMMARY

Visual perception plays a fundamental role in a prospective learner's ability to learn to read and spell; as well as in the accomplishment of written and numeracy tasks. Aspects of visual perception are facilitating functions and skills which a learner requires for acquiring basic literacy and numeracy proficiency. Yet, despite this importance, there exists no test that is standardised for the South African Foundation Phase population which adequately measures distinct visual perceptual aspects of individual learners.

The study was undertaken in an attempt to alleviate the dilemma of the South African Foundation Phase learners who tend to experience visual perceptual challenges that hamper their level of academic learning, performance and competency. Firstly, the literature study explored the construct of visual perception and focussed on the relationship between vision, visual perception and academic learning, performance and competency. Secondly, in order to adequately measure the South African Foundation Phase population's visual perceptual level of proficiency a new test was developed. Based on the literature study and the empirical investigation recommendations to educational psychologists, teachers, parents and learners have been made.

KEY TERMS

- Foundation Phase Learner
- Perception
- Standardised Test
- Visual Perception
- Visual Perceptual Aspects
- Visual System

DIE ONTWIKKELING VAN DIE VISUELE PERSEPSIE TOETS VIR LEERDERS IN DIE GRONDSLAGFASE

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OPSOMMING

Visuele persepsie speel ‘n fundamentele rol in die voornemende leerder se vermoë om te leer lees en spel; sowel as in die bereiking van literatuur en syferkundige take. Aspekte van visuele persepsie fassiliteer funksies en vaardighede, wat ‘n leerder benodig om basiese letterkundige en syferkundige bekwaamheid aan te leer. Onopgemerkte visueel-perseptuele uitdagings het ‘n tendens om leerders se kognitiewe, sosiale en emosionele lewens te beïnvloed. Tog, ten spyte van hierdie belangrikheid, bestaan daar geen toets wat gestandaardiseer is vir die Suid-Afrikaanse Fondasiefase populasie waarmee spesifiekde visueel-perseptuele aspekte van leerders akkuraat getoets kan word nie.

Hierdie studie is onderneem om die dilemma van dié Suid-Afrikaanse Fondasiefase leerders wat visueel-perseptuele uitdagings ervaar te verlig waardeur hulle vlak van akademiese prestasiete en bevoegdheid belemmer word. Eerstens het die literatuurstudie die konstruk van visuele persepsie verken. Die fokus is geplaas op die verhouding tussen visie, visuele persepsie en akademiese prestasie. Tweedens is ‘n nuwe toets ontwikkel, waardeur die populasie van die Suid-Afrikaanse Fondasiefase leerders se visueel perseptuele bedrewendheid gemeet kan word. Aanbevelings aan opvoedkundige sielkundiges, onderwysers, ouers en leerders is gemaak, gegrond op die literatuur - sowel as die empiriese studie.

SLEUTELTERME

- Grondslagfase Leerder
- Persepsie
- Gestandardiseerde Toets
- Visuele Persepsie
- Visuele Persepsuele Vaardighede
- Visuele Sisteem

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CHAPTER 1
INTRODUCTORY ORIENTATION, PROBLEM ANALYSIS, CONCEPT DEFINITION AND AIM

1.1 INTRODUCTION

Visual perception plays a fundamental role in a prospective learner's ability to learn to read and spell, as well as in the learner's accomplishment of written and numeric tasks. Aspects of visual perception are the facilitating functions and skills that a learner requires for the acquisition of basic literacy and numeracy proficiency. Visual perceptual aspects such as matching of forms (similarities), form constancy (irregular letter formation), visual recognition, form recollection (visual memory), and the directional orientation of visual stimuli are essential for academic leaning, performance and competence (Flax 2006:186). Undetected visual perceptual challenges (struggling to adequately process visual information) tend to affect not only the cognitive but also the social and emotional lives of learners (Gunning 2006:25-60; Kuhn & Siegler 2006:10; Schneck 2005:421). Early identification, in conjunction with appropriate intervention, can minimise long-term challenges such as:

- The ineffective acquisition of specific basic literacy and numeracy abilities preventing the neural processes and procedures that facilitate automaticity.
- A discrepancy that develops between the learner's potential to learn and the learner's actual achievement level.
- The development of emotional problems that have a tendency to manifest in the intra- and/or interpersonal relationships of the learner's life.

Several authors (Bateson, Borsting, Cotter, Frantz, Garzia, Hoffman, Miller, Press, Rouse, Ryan, Steele & Williams 1997:73; Brown, Rodgers & Davis 2003:3; Deiner 2005:239; Engelbrecht 2004:253; Hard, Aring & Hellström 2004:633; Irlen 2005:2, 86; Lane 2005:8; Lerner 2000:21; Van Romburgh 2006:2) agree that early identification and appropriate intervention is crucial.

In formal education, the fundamental objectives focus on a learner learning how to read, write, spell and do mathematics. The majority of learners generally accomplish these anticipated objectives within the allocated timeframe (Rosner 1993:25). Research, however, indicates that approximately twenty percent of learners do not achieve academic competency in specific basic literacy and numeracy skills. Rosner (1993:25) contends that, although there may be more than one underlying problem, the most generalised related problem could be directly linked to a lag in the identified learner's development of specific, basic perceptual aspects and/or language abilities. Erhardt and Duckman (2005:171) as well as Kirk, Gallagher, Anastasiow and Coleman (2006:123) agree with this observation. Furthermore, they argue that it is not considered sensible to delay, ignore or expect that the learner will automatically outgrow basic perceptual challenges. If any visual or visual perceptual challenges are not detected, or more importantly attended to, then an unnecessary amount of stress is placed on the learner's central nervous system (CNS). This stress can trigger various flight-or-fight responses within learners (Cheatum & Hammond 2000:13; Gunning 2006:44), which are then expressed through their behaviour (Finestone 2004:65; Rief & Heimburge 2006:105-106). For example, such learners may resort to behavioural outputs, such as overcompensating, task avoidance or refusal within a classroom situation (Cheatum & Hammond 2000:263-264; Gunning 2006:44-45; Winkler 1998:6).

Effective visual perceptual aspects facilitate not only learning, but also the academic performance and competency of learners. Within the South African context, the *Revised National Curriculum Statement* (RNCS; 2003:34) accentuates the importance of identifying barriers to learning during the Foundation Phase. Yet there exists no standardised test which can be used to adequately measure distinct aspects of visual perception in Foundation Phase learners. The following question, therefore, arises: *Is there is a need for a standardised test to adequately discern the visual perceptual status of the South African Foundation Phase learner who experiences challenges in basic academic learning?*

1.2 ANALYSIS OF THE PROBLEM

Efficient aspects of visual perception are essential for the effective processing of visual information and learning to accomplish formal academic tasks and activities. In spite of this, there is no standardised test for South African Foundation Phase learners, which adequately measures the distinctive nature of visual perception. Foxcroft and Roodt (2001:101) and the Health Professions Council of South Africa (2007:1) maintain that it is crucial to adapt appropriate assessment instruments in order to eliminate any bias from these identified psychometric tools within multicultural South Africa.

Visual perception tests, like the American standardised Bender-Gestalt Visual Motor Test (Bender-Gestalt) and the Beery-Buktenica Developmental Test of Visual-Motor Integration (Beery-VMI) are effective tests which purport to measure the construct of visual perception. These well-known tests, however, are more apt to measure modalities of visual-motor integration (Sattler 2002:225) and do not clearly discern challenges relating to distinct visual perception aspects. For example, a learner who experiences a challenge in performing either the Bender-Gestalt or Beery-VMI may be deficient or lagging in either the area of visual perceptual, visual-motor integration and/or motor proficiency. There is no way of explicitly knowing, when using the above-mentioned tests alone, which specific aspect of visual perception requires attention (Cummings, Hoida, Machek & Nelson 2003:500; Sattler 2002:218). Furthermore, this may lead to the use of an inapt intervention programme. Any inappropriate individual support plan (ISP) can result in a frustrated learner who tends to display minuscule or modest academic improvement. Feelings of a lowered self-esteem then transpire which whittle away at a learner's sense of self-worth.

The above-mentioned tests are widely used in South Africa as part of an assessment battery (Foxcroft, Paterson, Le Roux & Herbst 2004:24). This practice is not only prevalent among educational psychologists, but also other assessment practitioners. However, no full-scale national normative study has as yet been undertaken (Foxcroft et al 2004:24) and to date, psychological assessment practitioners within South Africa have not been provided with appropriate standardised norms for the South African population for either the Beery-VMI or Bender-Gestalt test.

Within the South African context, the Junior South African Individual Scales (JSAIS) provides normative visual perceptual subtests within the standard Global IQ battery (Form Discrimination, Absurdities A, Form Board and Block Design) and within the additional subtests (Visual Memory, Gestalt Completion, Grouping, Picture Puzzles and Copying). The Senior South African Individual Scales – Revised (SSAIS-R) also includes normative visual perceptual subtests (Pattern Completion, Block Designs and Coding). However, these subtests are not pure measurements of distinct visual perceptual aspects. The JSAIS and the SSAIS-R subtests form part of a Global IQ battery for ages between three years naught months to eight years (Madge 1998:4) and between seven years and sixteen years eleven months (Van Eeden 1991:1), respectively.

Traditional block design and copying tasks include a motor component. Korkman, Kirk and Kemp (2007:12) caution that any motor component tends to influence the learner's performance. As early as 1986, Cratty (1986:311) had warned of the "contamination" of potential motor ineptness in the measurement of visual perceptual ability. For example, a learner may be unfamiliar and therefore unable to use a pencil or pen adequately.

In the researcher's experience, these tests were not designed to indicate specific deficiencies in distinct (discrete or separate) visual perception aspects, particularly with regards to the assessment of Foundation Phase learners who portray learning challenges.

The researcher proposes that access to a test, which is predisposed to the discernment of distinct aspects of visual perception, would facilitate an educational psychologist's ability to:

- provide more appropriate referrals,
- offer informed recommendations and/or,
- design a more apt intervention programme for an individual learner.

Therefore, based on the researcher's personal observations and experiences with learners, as well as various consultations with lecturers and peers, the researcher perceives a need to develop a standardised test for measuring distinct visual perceptual aspects of South African Foundation Phase learners. The researcher believes that an accessible test will assist in a more comprehensive and systematic gathering of relevant information relating to the Foundation Phase learner's level of visual perceptual ability and functioning. Moreover, as a diagnostic tool, the test could assist the educational psychologist in making appropriate informed decisions with regard to relevant recommendations, intervention or any possible referral that may be essential for appropriate learning support.

1.2.1 Exploration of the problem

The majority of children, whether playing or functioning within an academic environment, have a tendency to learn through the regular use of their eyes (Gates 2004:37; Gentile 2005:2). Carey (2006:1) simply defines vision as "knowing what is where by looking". On average, the primary learning channel is vision (Sattler & Evans 2002:369). Previous research indicates that approximately 20-30% of learners tend to learn more effectively through the auditory channel (to recall what is heard), while 40% of learners tend to learn more effectively when presented with visual information (to recall what is seen; Schneck 2005:420).

Visual perception is the ability to provide specific meaning to that which is seen. According to Harris (2007:1), the concept of *sight* refers exclusively to an individual's ability to see, whereas *vision* refers to the brain's ability to organise, interpret and understand the information that comes to it through the eyes. For that reason, vision is a fundamental part of the developmental process of visual perception.

1.2.1.1 The visual system: sight versus vision

The eye is a light sensitive organ and the visual system's first component in processing visual information (see section 2.4.1). An individual's visual system consists of three key sections:

- the eyes, which capture light and generate electrical messages about this light,

- the visual pathways, that transmit neural messages from the eye to the brain, and,
- the pertinent visual centres of the brain, which interpret and organise the neural messages in various and specific ways (Rookes & Willson 2000:4-10).

There are three fundamental processes of vision: visual acuity, vision efficiency and visual information processing (Borsting 2006:35). The learner initially requires sight to see the visual stimulus (Cummings et al 2003:514), namely adequate clarity (visual acuity). Visual efficiency, which is preceded by visual acuity, is the learner's ability to be attentive to the specific visual stimulus. These two processes (visual acuity and efficiency) facilitate visual information processing, namely the analysis, interpretation and categorisation of what is seen. Visual perception forms part of a broad group of visual perceptual and cognitive aspects which facilitates the processing of visual information (Borsting 2006:43).

The first stage of visual perceptual processing is executed by the retina (Twining 1998:127). The remaining perceptual and cognitive stages of visual perception occur within the optic nerve, the lateral geniculate nucleus and the visual cortex of the brain (see section 2.4.3). Visual perception is a learnt phenomenon (Gordon 2004:153; Williams 1983:73) which necessitates a process of changing a seen and selected image into "useful" information. This process places demands on the individual's visual system and central nervous system (Cheatum & Hammond 2000:266), which influences behavioural output (Finestone 2004:65).

1.2.1.2 Visual perception

According to Kellerman and Arterberry (2006:114),

> "... the function of visual perception is to provide the perceiver with information about the objects, events and spatial layout in which the individual is required to think and act."

The process of visual perceptual development begins at birth (Schneck 2005:418-419) in a relatively sequential manner (Bergh & Theron 2003:64; Brockett 2006:1) and is learnt over a period of time (Cheatum & Hammond 2000:266; Gordon 2004:153). All individuals, however, do not have equal opportunities to develop visual perception (Borsting 2006:44; Van Romburgh 2006:11). Reasons for this may include:

- the rate of visual perceptual development that tends to differ among individuals,
- the manner in which the visual perceptual aspects are acquired (learnt), or
- the different ways in which specific individuals utilise visual perceptual capacities with regard to efficiency, adaptability and consolation of the particular aspect of visual perception (Levine 1987, as cited in Schneck 2005:419).

The sequential process of visual perceptual development can be thwarted, halted, or even changed at any stage of an individual's development. Potential delays in the development of visual perception may relate to:

- a lack of appropriate stimulation,
- emotional trauma,
- a possible injury or illness, or
- other unidentified causes.

If visual sensory input is "distorted", then any behavioural output based on the misrepresented information will possibly be warped (Brockett 2006:1; Cheatum & Hammond 2000:263). Just like any other human system, the visual system is not always perfect (Carey 2006:4) and may be immature or can become dysfunctional (Irlen 2005:1). This places the individual learner at risk of developing learning-related visual and/or visual perceptual challenges (Bateson et al 1997:71; Rosner 1993:25; Tomlinson 2007:3).

1.2.1.3 Learning challenges experienced in academic performance

On average, learners who struggle to learn tend also to experience visual perceptual challenges (Deiner 2005:233). *Learning* refers to the process whereby the individual's experience manifests in a change in thoughts, feelings and behaviour (Shaffer & Kipp 2007:3). Previous research reflects that within all cultures there is a heterogeneous group of learners who seem to have normal intelligence, yet experience difficulties in acquiring basic skills in reading, writing and/or accomplishing mathematical tasks (Lerner 2000:6; Retief & Heimburge 2006:36). There are no intellectual, geographical or ethnical boundaries to define learning challenges (Rosner 1993:25; Sattler & Weyandt 2002:282; Snowling 2005:683; Sousa 2005:6). These authors also maintain that the effects of learning challenges experienced by learners tend to vary on a continuum. This gamut can range from mild (i.e. a temporary developmental delay) to moderate (i.e. an unidentified maturational lag) to severe (i.e. visual perceptual dysfunction).

There is a tendency, when disorders are labelled (e.g. reading disorder), to only describe the surface manifestations of such challenges. The implications relating to either the aetiology or the required intervention for the particular disorder are rarely conveyed to the learner, parents or educators (Snowling 2005:683). Levine (2002:14), as well as Rosner (1993:4) and Shaywitz (2003:3), emphasise the concern and perplexity of educators and parents regarding this problem. There exists a general consensus that knowing the cause of a disorder may serve as a point of departure for assessment, diagnosis and assistance (Gunning 2006:23). When a learner is diagnosed with a challenge in processing and/or analysing visual information, which influences specific academic achievements, the learner tends to feel less frustrated and despondent in the classroom if the actual problem has been identified, explained, understood and is being aptly addressed (Irlen 2005:82). Levine (2002:278) states that the process of "demystification" of any learning challenge facilitates "a sense of soothing." This demystification can provide empowerment to challenged learners. Learners therefore ought to have knowledge about their academic challenges. Furthermore, learners also need to understand how to personally address these challenges. Engelbrecht (2004:252) points out that if information and skills are shared by working in collaboration with the role-players – especially with the parents (the primary interventionists of the learner) and educators – success is more likely to transpire.

1.2.1.4 Reading, perceptual skills, readiness and aspects of visual perception

Reading, as an operational process, is a developmental task which involves the individual's sensory, motor and cognitive systems (Sousa 2005:121). For any learner to succeed at reading, explicit basic perceptual aspects (both visual and auditory) are fundamental. The initial, fundamental cornerstone of reading is graphophonics and the knowledge of orthography. An important part of graphophonics and orthographical knowledge involves visual perception, i.e. visual discriminatory, memory, spatial orientation and analytical aspects (Retief & Heimburge 2006:37-38).

Graphophonics is the relationship between symbol (visual configuration) and sound (phonology; Bouwer 2004:97). *Orthography* is a particular language's mode of spelling (the degree of sound-symbol relationship in that specific language). South African indigenous languages and Afrikaans are implied to have regular sound-symbol relationships (shallow orthographies, which necessitates predominantly auditory analytical processing of printed text; Bouwer 2004:93). However, abundant unpredictable sound-letter relationships appear within the English language (a deep orthography which generally requires predominantly visual, holistic processing of printed text; Bouwer 2004:93; Gunning 2006:42).

As a spatio-temporal process reading depends on various levels and skills (Ram-Tsur, Faust & Zivotofsky 2008:437). Learning to read requires the brain to process on no less than seven different levels (Sousa 2005:217). A learner is required to master multiple and specific fundamental skills (Deiner 2005: 397-461; Frederickson & Cline 2006:306; Gunning 2006:23; Sattler & Weyandt 2002:291). *Skill*, according to the *Heinemann English Dictionary* (2001:950) implies "an ability to do something well, due to knowledge, practice or training". Reading also requires years of intentional effort of practice (Sousa 2005:1) to automate fluency (Frederickson & Cline 2006:306). A significant phenomenon of any skill acquisition is automaticity (Schneck 2005:426). *Automaticity* refers to those automatic processes and procedures which develop with the maturation of an acquired skill (Groffman 2006:255; Schneck 2005:426). When compared to their peers, however, a number of learners do not appear to be "ready" to acquire the rudimentary skills required to read (Deiner 2005:233; Kurtz 2003:121). In particular, these learners do not possess the maturity to meet the challenges of the complexity required by the reading process. *Readiness* refers to a point in development where the learner has matured sufficiently to benefit from learning or experience (Craig & Baucum 2002:65). According to Lerner (2000:191),

> "the concept of readiness refers to the state of maturational development and prior experience that are needed before a target skill can be learned".

The developmental perspective maintains that the ability to learn depends on a learner's maturational status (Lerner 2000:187). Readiness within the school environment relates to "the degree to which an individual has acquired the skills considered prerequisite for academic learning" (Sattler & Weyandt 2002:329). Learners within the South African context, enter formal education at an older age than the majority of their overseas peers. Therefore, South African learners are instructed in basic literacy and numeracy skills at a later developmental stage. Notwithstanding their physical maturity, the majority of South African learners, especially the rural learners, have not been fully exposed to printed material or a formal learning experience before entering a formal educational environment.

According to Deiner (2005:397), what is fundamental to learning to read is the individual learner's ability,

> "... to make fine distinctions between letters and patterns of letters, as well as spaces between words".

Schneck (2005:425-426) states that reading proficiency depends on:

- the ability to identify various symbols (graphic visual configuration) and order of letters in a particular language (orthographical knowledge),
- the ability to detect separate phonemes in a word (phonological awareness),
- the ability to grasp the various rules of a specific language (syntax), which necessitates a simultaneous application of these rules, and
- an automatic understanding of what has been read (comprehension).

Similar information was given by Frederickson and Cline (2006:306); Sattler and Weyandt (2002:291); and Sousa (2005:18-19, 28). Visual perception is the brain's ability to organise and interpret what is seen (Deiner 2005:233). Visual perceptual aspects therefore facilitate the breaking down of the visual image to identify and cognitively map out structural components (the feature identification of "the what") in conjunction with its spatial interrelationships ("the *where*" aspects; Lane 2005:9; Rosner 1993:26). However, various authors differ on which aspects of visual perception are important to a prospective learner to master competency in formal school activities (see section 2.9). Notwithstanding this, authors generally agree on the importance of the following visual perceptual aspects:

- visual discrimination
- visual memory
- visual sequential memory
- visual spatial relationships
- visual figure–ground discrimination
- visual closure.

1.2.1.5 Relevant research

In the initial investigation of literature on visual perception and the relevant basic emergent literacy and numeracy skills, it became apparent that no study could be traced with regard to specific distinct aspects of visual perception, the basic academic acquisition (literacy and numeracy) and the population of South African Foundation Phase learners.

The majority of studies and written material on visual perception were generated overseas (i.e. the UK or USA). As early as 1982, Kavale (1982:42-51) used a comprehensive meta-analysis to integrate statistical results (from 161 studies) to examine the relationship between specific visual perceptual skills and reading achievement. Groffman (2006:248) describes a *meta-analysis* as the result of various, independent studies which are statistically integrated. Kavale (1982:42) concludes that, within the complexity of factors which play a role in reading achievement, aspects of visual perception should be included. Various contemporary researchers (Cummings et al 2003:500; Groffman 2006:248; Schneck 2005:419) continue to report on the significant relevance of Kavale's published research.

In a more recent study, Woodrome (2005:1) explored the role of visual discrimination in the learning-to-read process. The results of the study indicate a significant association between visual discrimination and lowercase letters.

A study undertaken by Badian (2005:28) investigated whether visual-orthographic aspects (the ability to recognise whether letters or numerals are oriented correctly) contributed to the variance in reading. The study found that the ability to recognise the letter/numeral orientation did, in fact, contribute to reading. The study also found that learners with deficits in visual-orthographic orientation were poorer readers than learners without such a deficit (Badian 2005:48).

1.2.1.6 Visual perception and other basic literacy and numeracy skills

Reading is a core skill in learning to spell, write and accomplishing various mathematical tasks. According to Jooste and Jooste (2005:392), an integration of adequate visual, auditory and tactile information as well as eye, ear and hand functions is necessitate for reading, writing and copying. These basic academic skills therefore require simpler perceptual and cognitive tasks such as the discrimination of shape or objects (letters, words, and numbers) and learning about the patterns and relationships of these shapes and objects (Deiner 2005:397).

Spelling is the “ability to construct an order of letters in words according to prescribed rules” (Dednam 2005a:128). There is a tendency for similar aspects of visual perception which interfere with the learner’s ability to learn to read; to also hamper the learner’s spelling ability (Flax 2006:202). This interference tends to persist despite the fact that a learner has mastered reading significantly. For instance, the learner has either mastered the phonic analysis of words or has rote learnt words (enhanced the visual memory) to read.

According to Kurtz (2003:121), writing requires specific aspects, such as control of posture (gross motor control), the capacity to perform isolated movements of the hand’s small muscles (fine motor control), motor planning, visual discrimination, perceptual organisation, as well as cognitive and language processing. Dysfunctional handwriting characteristics, which relate to visual perception, are evident in the inconsistent manner a learner forms letters and/or numbers (visual discrimination and memory aspects) and/or the visible reversals or impaired spacing (spatial orientation) of letters, words or numbers in written tasks (Dednam 2005a:128). Writing is influenced by defective visual and/or tactile perception (Jooste & Jooste 2005:392). If learners experience visual perceptual challenges, their penmanship becomes a laboured task. These learners apply extensive effort to the manual output resulting in fatigue and/or the incompletion of tasks within the allotted time frame. As a result of this laboured effort and fatigue there is a shortfall of concentration on the content of the written piece.

In Mathematics visual perceptual aspects provide meaning to data (Dednam 2005b:201) According to Korkman et al (2007:16), factors which underlie challenges in mathematics are usually not well researched or understood. Assessments of reading commonly tend to emphasise progressively developing language skills. Assessments of mathematics, however, tend to focus on the processes of visual perception, which are linked to particular developing mathematical skills (Korkman et al 2007:16). Learning challenges in mathematics have therefore frequently been related to deficiencies within the learner's visual spatial ability and/or visual motor association aspects (Groffman 2006:270). The organisation of written or printed mathematical symbols therefore present challenges to the learner who experiences visual-perceptual challenges; left-right confusion or sequential problems (Dednam 2005b:201; Frederickson & Cline 2006:347).

The relationship between distinct visual perceptual aspects and basic academic skills such as reading, spelling, writing and mathematics will be discussed in the literature study (see section 2.9 & 2.10).

1.2.1.7 Measures of visual perception

During a standard psycho-educational evaluation, the assessment of visual perceptual aspects forms part of the assessment of a learner's cognitive functioning (Selznick & Blaskey 2006:418). This evaluation is important in identifying potential challenges to learning and/or any neurological deficit related to the learner's capacity to process information (Sattler 2002:213).

Tests like the Bender-Gestalt and Beery-VMI tend to merely highlight possible challenges relating to visual perception and focus more on facilitating the identification of modality deficiencies, such as eye–hand coordination, visual–motor integration deficits, or a diversity of challenges relating to the graphic representation of what is seen by the individual (Cummings et al 2003:500). Hamill, Pearson and Voress (1993:4), as well as Salvia and Ysseldyke (1998:596 in Deiner 1999:362) reported on findings regarding measures of visual perception. They concluded that clinicians and researchers were hindered by a lack of appropriate tests. In addition, they reported that tests were technically inadequate to measure distinct visual perceptual aspects.

The researcher would like to explore whether an assessment (i.e. a specifically designed visual perceptual test) can identify distinct visual perceptual aspects required for academic learning and proficiency within the South African Foundation Phase population.

1.2.2 Statement of the research problem

The preliminary literature study highlights the fundamental role of visual perception in the acquisition of basic literacy and numeracy skills. Accordingly, when certain aspects of visual perception are inefficient, it contributes negatively to a learner's learning process or academic performance and competency. Purposeful support is only possible if the refined nature of the Foundation Phase learner's strength, delay or lack of visual perception is determined. Although there are valued tests which purport to measure the construct visual perception, the researcher is of the opinion that these tests do not adequately measure the distinctive nature of visual perception. Nor have full-scale, national, normative studies been done on these imported tests for the South African Foundation Phase population.

For this reason, the proposed study attempts to investigate the following key research question:

> ***What content needs to be included in a test to adequately measure the visual perceptual aspects of learners within the South African Foundation Phase?***

The proposed investigation uses the following inter-related questions to ensure that the primary research question is addressed:

- *What is visual perception?*
- *What aspects of visual perception are required to master academic learning?*
- *What components are required to develop a test that purports to measure aspects of visual perception of the South African Foundation Phase population?*
- *How do various visual perceptual aspects relate to the South African Foundation Phase learner's ability to learn to read and spell, as well as accomplish written and mathematical tasks?*

1.3 THE AIM OF THE RESEARCH

The principal aim of this research study is to develop a test which adequately assesses and evaluates the distinct visual perceptual aspects which is required for academic learning, performance and competency, of South African Foundation Phase learners. The research study is divided into two focus areas, namely the literature study and the empirical investigation.

The aim of the literature study is to gain a comprehensive understanding of the construct visual perception and the various visual perceptual aspects necessary for academic learning and competency within the Foundation Phase. In order to reach this aim, the researcher:

- Discusses various definitions, theories and approaches relating to visual perception.
- Explores distinct visual perceptual aspects within formal education. Factors which tend to influence the development of visual perception within the Foundation Phase learner

are also identified. This step will facilitate the development of the test (i.e. what content is required in the test) and, ultimately, the recommendations made regarding the support of a learner with visual perceptual challenges.

- Gives a brief critical analysis of various commercially available methods used to measure the construct of visual perception.

With the empirical investigation, the researcher aims to:

- Develop a reliable test, which will measure the visual perceptual aspects required by the South African Foundation Phase learner.
- Establish how visual perceptual aspects impact and influence the Foundation Phase learner's ability to learn to read and spell, and to accomplish written and mathematical tasks.

1.4 CLARIFICATION AND DEFINITION OF KEY CONCEPTS

An integral part of the research study is to clarify the various key concepts employed. A deductive approach is used to explain the respective meanings of the identified key concepts within the context of this research study.

1.4.1 A standardised test

Test, according to the *Heinemann English Dictionary* (2001:1066), implies "… a procedure to determine quality, ability, composition …" To standardise a form of measurement, a test is administrated to a sample taken from an identified population (see section 3.3). Data obtained from the sample can be used to determine the reliability (see section 4.3) and validity (see section 4.4) of the newly developed test.

According to Sattler and Weyandt (2002:329), *norms* are the standards of performance which are determined by testing a reference group and calculating standard scores for this representative group's test performance. Norms are also determined in order to compare an individual's score to that of the standardised sample (see section 4.5).

1.4.2 Visual perception

Perception occurs in the brain and refers to the meaning an individual attaches to the selected information received through, or gathered by, the various senses. Scott (2003:24) defines perception as a process which occurs when the brain identifies and makes meaning of the information sent to it through messages from the sensory organs. Information collected through the senses, i.e. perception of the outside world, is the foundation for learning (Groffman 2006:242). It is the role of perception to develop the individual's ability to pay attention (Gordon 2004:156). The selective process of perception determines what information will be eliminated or retained for further processing (Adams 1997:7).

Visual, auditory and tactual-kinaesthetic perceptions are fundamental to ensure that a learner performs adequately in various school-related activities (Dednam 2005c:370; Retief & Heimburge 2006:37-39). There are various definitions for the term visual perception (see section 2.3) ranging from being able to detect various forms to the complexity of interpreting images (Loikith 2005:145). According to Beery (1997:16–17; 2006:10),

> "visual perception is probably best defined as the interpretation of visual stimuli, the intermediate step between simple visual sensation and cognition".

Zaba (1984, as cited in Schneck 2005:412), however, defines visual perception as the sum of the processes responsible for the reception (sensory functions) and cognition (specific mental functions) of visual stimuli (see section 2.9).

After reviewing the relevant literature, the researcher defines visual perception as the individual's sensory and cognitive ability to be attentive to visual stimuli in order to comprehend what is seen. Both the structural components of the feature identification (the what) and the spatial interrelationships awareness (the where) facilitate the capacity to identify, organise, analyse and interpret the seen image.

1.4.3 The Foundation Phase learner

The South African Schools Act (1996:4) defines a *learner* as any individual who is receiving education or who is obliged to receive education. The term learner replaced other terms and refers to all individuals (as defined above) ranging from early childhood education through to adult education (Quality education for all 1997:vii). Within the South African context formal education is grouped according to three levels: General Education and Training (GET), Further Education and Training (FET) and Higher Education (HE). The first phase of the General Education and Training band (Grades R, 1, 2 and 3) is known as the Foundation Phase (Revised National Curriculum Policy, 2003:19). According to Notice No. 2432 of 1998, and the National Education Policy Act (Act no 27 of 1996), learners in the Foundation Phase (Grades R–3) may range between the ages of five and ten years. The School Admission Policy states that a learner can only be admitted to Grade 1 at the age of five if the learner turns six on or before 30 June of the respective year. It further states that if, for some reason, the parents believe their child is not school-ready at age five (turning six) they may register their child for Grade 1 at age six (turning seven). Grade R is not yet compulsory within the South African context.

1.5 RESEARCH PROGRAMME

In Chapter 1 the research problem, aim and the outline of the empirical research study were discussed. The research is separated into two focus areas: a literature study and an empirical investigation.

Chapter 2 provides a literature study pertaining to the construct of visual perception in general and, more specifically, the aspects of visual perception that the Foundation Phase learner is confronted with daily. Various definitions, theories and approaches relating to visual perception are explored. The various aspects of visual perception and the factors influencing the development of these aspects within the Foundation Phase learner, is investigated. A brief, critical analysis of various commercially available methods to measure the construct of visual perception is given. This analysis provides support for the development of a new visual perception test.

Chapter 3 contains the research design of the empirical investigation. Given that no standardised test exists to measure the visual perceptual aspects of South African Foundation Phase learners, this chapter deals with the development of such an explicitly designed test. Hypotheses that relate to the research statement are formulated. One of the problem statements revolves around the development of a reliable and valid test by which visual perceptual aspects can be measured. Therefore, the method used to develop this test is stipulated, and the manner in which the sample was selected as well as the research procedure that was followed during the testing phase, are discussed in Chapter 3.

Chapter 4 gives an explanation of the results of the empirical investigation. Firstly, the psychometric characteristics of the new test are discussed, including the item analysis, reliability, validity and development of norms. Secondly, the methods employed to test the hypotheses, as stated in Chapter 3, are explained.

Chapter 5 outlines the implications of this research study on education. This chapter primarily focuses on recommendations and suggestions for the improvement of assessing, diagnosing and intervening. The contribution and limitations of the study are discussed and suggestions for further research are given.

CHAPTER 2

VISION, VISUAL PERCEPTION AND ACADEMIC PERFORMANCE

2.1 INTRODUCTION

Aspects of visual perception are fundamental to the learning process. Excessive demands, particularly in the early stages of formal education, are placed on the learner's visual perceptual aspects throughout academic learning. Visual perception involves the active process of identifying, analysing and interpreting visual information. Learning comprises the process of acquiring information through experience and the storing of information (Groffman 2006:242).

As the individual's brain endeavours to process information, received daily from a myriad of sources, the dominant sense of vision not only receives (sight; Landsberg 2005:334), but also processes visual stimuli for the brain to identify, analyse and interpret (visual perception). Wade and Swanston (2001:3) point out that, with relatively few mistakes, any average individual's visual perceptual abilities can effectively provide accurate information about the diverse characteristics of any given environment. They contend that the power of visual perception is manifested in its success to provide such "flawless" information to its perceiver. Questions regarding learners within the school environment and the importance of visual perception to master learning and academic competency, arise: *How important is it for individual learners to receive faultless visual information when learning to read, spell and accomplish various written and mathematical tasks? How do visual perceptual aspects develop within a formal education environment ensuring adequate visual perceptual functionality for academic learning, performance and competency?*

For the average learner to succeed academically, the attainment of explicit developmental phases (see section 2.7) and sound physiological structures (refer to Appendix A) are required. However, there is a percentage of the heterogeneous group of learners who experience perceptual-cognitive challenges in acquiring academic skills in literacy and/or numeracy (see section 1.2.1.3). Further questions, therefore arise: *Is there a minimum level of visual perceptual competency required to learn to numerate, read or write? How can the learner's functioning level of visual perceptual competence be discerned?*

When educational psychologists assess and evaluate a learner who experiences challenges in academic learning, the most important tools available include not only acquired clinical skills, but also appropriate, reliable and valid measuring instruments (Cummingham et al 2003:498-499). There is, however, no standardised test which can ascertain the distinct aspects of visual perception of South African Foundation Phase learners to facilitate informed decision-making regarding appropriate recommendations for either referral or intervention.

The aim of this research study is to identify the essential contents to develop a visual perception test (see section 1.2.2). This test should adequately measure visual perceptual aspects of the population of South African Foundation Phase learners (see section 1.3). The literature study, as discussed in this chapter, is therefore concerned with conceptualising the construct of visual perception and, more importantly, identifying the distinctive aspects of visual perception (the functionality and skills) which Foundation Phase learners need to develop for optimal academic learning, performance and competency.

The purpose of this chapter is to provide a framework to understanding what visual perception is, how it develops, and to investigate which crucial distinct aspects of visual perception are essential for academic learning and competency, particularly concerning Foundation Phase learners. This chapter will commence with a brief description of the Foundation Phase learner and the developmental stage of middle childhood. This literature study will facilitate the development of a visual perceptual test.

2.2 MIDDLE CHILDHOOD AND THE FOUNDATION PHASE LEARNER

Middle childhood (six-twelve years of age) is marked by slower, regular and stable growth (Ntshangase 2004:63). During this phase the learner is expected to display behaviour that is independent and responsible (Finestone 2004:67). According to Green (2001:81), this life-period is witness to the development of the individual's competencies on cognitive, social and personal levels. Mash and Wolfe (2002:408) state that *competence* refers to:

> "… the ability to adapt to one's environment. Children's competence involves their performance relative to their same-age peers, as well as their individual course of development".

Bjorklund (2000:365) is of the opinion that several cognitive abilities only develop within a specified context (i.e. school). School is a major formative experience (Kirk et al 2006:325). Schooling therefore plays a crucial role in healthy development by facilitating the acquisition of cognitive, social, personal and emotional competencies (Craig & Baucum 2002:346). The majority of children experience maturation of language, cognitive, social and perceptual-motor aspects. This maturation of the nervous system and the various interactions of acquired skills, facilitate the learning process (Craig & Baucum 2002:338). Learning becomes easier and, therefore, more efficient as the neural processes and procedures become more fluent and achieves automaticity (see section 1.2.1.4).

Piaget proposed that, during this cognitive developmental stage (seven to eleven years), there is shift from pre-operational thinking to concrete operational thought. In this phase, thoughts become more logical and less egocentric and intuitive (Gordon & Browne 2008:145). For example, when comparing a five-year-old learner to a twelve-year-old learner, there is a difference in not only the amount of knowledge and information acquired but, also the profound thought processes and manner in which information is actually processed. Throughout this phase, learners seem intent on testing and challenging themselves not only physically, but mentally as well (Craig & Baucum 2002:332).

This developmental stage marks a time to learn and acquire new skills as well as to refine and consolidate previously acquired ones (Green 2001:80). The psychosocial development stage during this life period is referred to by Erikson, as the *industry versus inferiority* period*.* The main psychosocial dilemma of this phase is that the individual who has established trust, autonomy and initiative, now longs to develop skills to engage in meaningful work (Carr 2004:26). According to Hendricks and Weissman (2007:179), what truly fosters the basic attitudes of trust, autonomy, initiative and industry is competence. Learners therefore ought to emerge from this stage with new skills that have been mastered (e.g. educational and social skills), as well as a sense of competence and self-efficacy regarding these mastered skills (Kirk et al 2006:325 & 359). Carr (2004:26) points out that there are learners who do not have the ability to master the skills valued by society.

Learners face developmental challenges which relate to social-competence, self-control and the emergence of an elaborated self-concept (Finestone 2004:67). Green (2001:81) states that during this period, the learner acquires a sense of identity that is more differentiated. The learner gains insight regarding the self which is not only descriptive (e.g. *'I am a boy with green eyes'*), but also includes positive or negative comparison with others (e.g. *'He reads better than me'*) and how these characteristics are evaluated by other (e.g. *'My son struggles to read'*). Therefore, central to academic confidence is the school-aged individual learner's self-esteem (Craig & Baucum 2002:359).

In comparing the research of Sylwester (1995:72) and Jensen (1998:71), Wren (2007:84) argues that learning, thinking and emotions are all linked. Thus, if a learner who struggles to read, spell, write and/or to numerate perceives that his or her classmates are not experiencing similar challenges, it tends to be detrimental to that learner's self-esteem (Irlen 2005:2; Kuhn & Siegler 2006:10).

Mash and Wolfe (2002:308) note that, even though learners may not understand the “how” and “why” of their struggle, they do understand how it feels to be different, and the continuous battle they experience to keep up with the continuous pace of their peers. Several researchers agree (Anderson, Gerrish, Layton, Morgan, Tilstone & Williams 2004:131; Donovan, MacIntrye & MacMaster 2002:101; Lerner 2000:537; Riddick 1996:107; Shaywitz 2003:120).

Middle childhood is characterised by mastering specific academic skills such as reading, writing, spelling and mathematics. When the learner experiences explicit visual perceptual challenges, these fundamental academic skills cannot be mastered effectively and usually results in failure. Repetitive failure may cause emotional distress and a low self-esteem.

Challenges can be identified and addressed with the access to and the use of a standardised test for discerning a learner’s visual perceptual status. Addressing these challenges early in a learner’s school career may prevent failures relating to visual perception and academic achievement as well as the emotional and psychological impact it may have on a learner.

2.3 DEFINING VISUAL PERCEPTION

As individuals explore the environment they rely on their senses to provide the necessary accurate information from or about their surroundings (Landsberg 2005:335). Erhardt and Duckman (2005:138) define visual perception “as the process of obtaining and interpreting information from the environment”. On average, about 80% of what individuals learn is assimilated through the visual system (Dednam 2005:370; Gentile 2005:ix; Landsberg 2005:334). Information that enters through the eye is continuously processed and aligned with a milieu of other information received through all the other sensory systems, as well as from various past experiences.

Visual perception, practically defined, is an individual’s ability to interpret or give meaning to what is seen. Yet Brown et al (2003:3), as well as Groffman (2006:254), Kavale (1982:41) and Schneck (2005:422) contend that there “remains a concern” as to whether there is consensus among psychologists and test developers regarding the definition of visual perception. This research study’s review of literature uncovered various definitions for visual perception.

Firstly, perception is defined as “stimulus-driven” (Loikith 1997:197). According to Williams (1983:73), visual perception is “a pick-up and analysis of sensory information from the external environment through the use of the visual mechanism”. Warren (1998:42-43) contends that the process of visual perception commences with the visual stimulus and subsequently proceeds through higher cognitive processes. Craig and Baucum (2002:175) maintain that it is not possible for this conscious experience to occur without external stimulation and for the conversion of sensation into neural impulses to take place. Rookes and Willson (2000:1) refer to *sensation* as "the responses of sensory receptors and the sense organs to environmental stimuli". Yet *perception* is a process which involves "the recognition and interpretation of stimuli that register on our senses" (Rookes & Willson 2000:1). Bergh and Theron (2003:104) note that sensation "entails the stimulation of sense organs", while perception "entails selection, organisation and interpretation of sensory stimulation".

Within psychological literature, goal-theories define visual perception as a "goal-driven" activity. Goal-theorists believe that it is the perceiver's intentions and cognitive abilities which initiate and regulate perception. Loikith (1997:198) refers to Piaget's description of visual perception as an activity which mentally acts on a visual scene. Piaget's emphasis was on "action" as opposed to sheer sensory associations (Kellerman & Arterberry 2006:109). According to Loikith's (1997:199) own framework, "visual perception is the point at which an individual's knowledge meets environmental opportunities".

Hamill et al (1993:1-2) argue that the majority of psychologists, occupational therapists and educators are in agreement with Beery (2006:10) who cites the work of Strauss and Lehtinen (1947), as well as the work of Witt, Elliot, Gresham and Kramer (1988) that visual perception is the intermediary step between sensation and cognition. The "receptive process" of visual perception can be separated into three specific levels:

- *sensation* which is simply the awareness of visual stimulus,
- *perception* which deals with concrete and non-symbolic properties (e.g. shape, size, colour, texture, position) of visual stimuli, and
- *cognition* which includes diverse mental processes of thinking, meaningful language or problem solving (Hamill et al 1993:2).

Yet Zaba (1984, in Schneck 2005:412) defines visual perception as the complete process accountable for the reception (sensory functions) and the cognition (explicit mental functions) of visual stimuli (see section 1.4.2).

In conclusion, after exploring literature the researcher believes that visual perception is a conscious, yet subjective and selective internal perceptual-cognitive process. This process involves an active identification, interpretation, categorisation and assigning of meaning to registered external factors. Meaning is gained when the perceiver mentally attends to and selects visual stimuli to focus on the retina of the eye. These stimuli are then processed by the visual system before being analysed by diverse brain centres.

2.4 THE VISUAL SYSTEM AND VISUAL INFORMATION PROCESSING

Several aspects of sight (to see) and visual perception (to understand and process what is seen) are directly related to academic achievement. In addition, how the learner approaches any new challenge, demand and/or expectation within the classroom situation also relates to educational attainment. As a physical and mental process, the neuromotor aspect of vision involves the ability to acquire meaning from eyesight. This process is critical in the learning process (Moore, in Gentile 1997:4). Visual perception, however, is not concerned with whether the learner can see adequately (visual acuity), but rather with how meaning is ascribed to what is seen (OSV453/OSV413-T 2002:103). Warren (1993:42), however, contends that basic visual skills form the foundation for visual perception. Figure 2.1 illustrates the hierarchical development of visual perceptual aspects within the central nervous system (CNS) as proposed by Warren (1993:43).

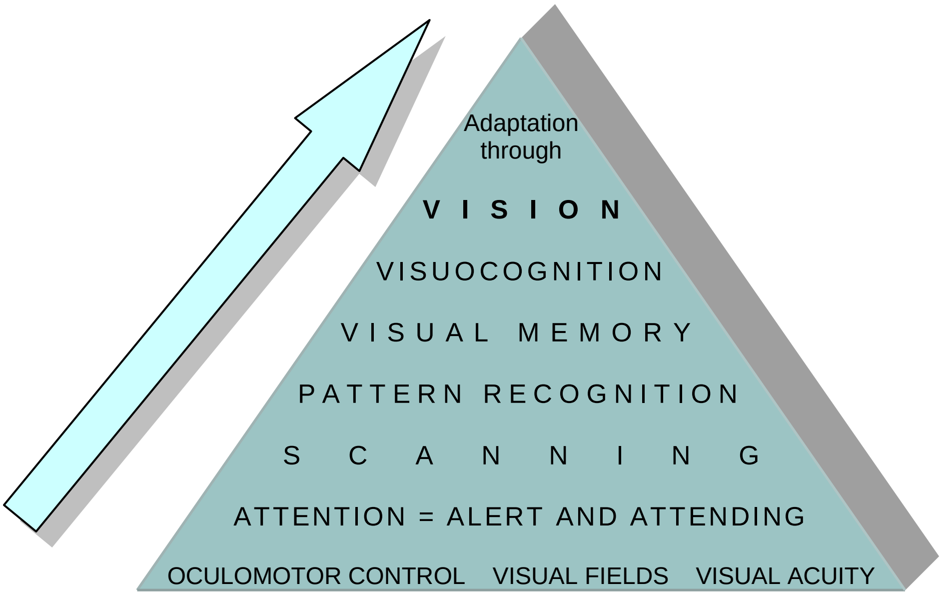


Figure 2.1: Hierarchy of visual perceptual aspects development in the CNS.
Source: Adapted from Warren 1997:43. (Original drawn by J. Moore).

Both Schneck (2005:417) and Van Romburgh (2006:28) refer to this diagrammatic representation when discussing visual perception. Both authors lay emphasis on the importance of this representation (fig 2.1), especially when developing a framework for visual perceptual evaluation and intervention. Twining (1998:127), Gregory (1998:38) and Rookes and Willson (2003:3) are of the opinion that to fully understand the aspects of visual perception it is imperative to have a basic grasp of how the visual system functions.

The primary function of the human visual system is to transmit visual information to the brain for processing and coding (Schneck 2005:412). The visual system can be divided into three main sections (see section 1.2.1.1), namely the:

- eyes,
- visual pathways, and
- visual centres of the brain which analyse the light patterns that fall on the retina (Bruce, Green & Georgeson 1996:86; Rookes & Willson 2000:4-10).

The spherical form of the eye is connected to the brain by means of the optic nerve (Landsberg 2005:331). For the brain to interpret visual perceptual information accurately, the visual system and its components need to work efficiently. If there are any problems with the structure of the eye or the way in which information is relayed to the brain, the learner will experience visual perceptual challenges. The educational psychologist with careful observations; the posing of relevant questions; and the employment of relatively simple eye assessments can assess the effectiveness of the learner's visual acuity and eye movements to a limited degree. Problems identified can be referred to the appropriate professionals for a comprehensive investigation. Due to the limited scope of this research study and the importance of a complete understanding of vision and how it relates to visual perception, the description of the visual system's three main sections may be found in Appendix A.

2.5 THEORIES OF VISUAL PERCEPTION

"How man perceives the world" has challenged many major theorists resulting in a variety of different explanations about how visual perception transpires. In 1959, Karl Popper (1902-1994) argued that no scientific theory could be proved precise, only as flawed or wrong. For this reason, each historical or modern theory, perspective or approach contributes to a greater understanding of perception (Goldstein 2001:2). It is therefore important to place each in its proper historical and philosophical contexts thereby understanding why these differ so widely and grasping the essentials of visual perception as well as how specific phenomena were discovered (Gordon 2004:3).

Authors like Gordon (2004), Kellerman and Arterberry (2006:109-114) and Roothe and Willson (2000:13-38) provide valuable insight in understanding how recent research has changed current conceptions of visual perception. Due to the limited scope of this research study, a broad overview in section 2.6 and 2.7 provides a brief insight into comprehending the complexity of visual perception and how it even now continues to challenge man.

2.6 UNDERSTANDING VISUAL PERCEPTION

Throughout history it is evident that philosophers, artists, physicians and psychologists have been captivated by the study of perception. However, the average individual just supposes that visual perception occurs automatically (Rookes & Willson 2000:2; Wade & Swanston 2001:1). In fact, Goldstein (2005:55), Gregory (1998:2 & 35) as well as Wade and Swanston (2001:2) have the same opinion - the majority of individuals have no thorough knowledge of what visual perception really entails or how it occurs. Schneck (2005:42) refers to Warren (1993:42), who contends that, despite visual perception being a major area of evaluation and intervention; it is the least understood by the majority of clinicians.

Visual perception is the end product or the result of a rather complex process (Goldstein 2005:76; Rookes & Willson 2000:106; Williams 1983:87). It is an active (Groffman 2006:242; Wade & Swanston 2001:1) and constructive process (Williams 1983:102; Cheatum & Hammond 2000:266) which locates, extracts and interprets visual information from the environment. Therefore, visual images obtained through visual acuity (the ability to see clearly) are changed into constructive information ("the what" and "the where").

In the past and still presently, the process has been studied from several perspectives. Bruce et al (1996:x) contend that there is value if *cross-fertilisation* occurs within research. Although various theories, approaches and perspectives exist, this research study will look broadly at the following three:

- cognitive
- neurobiological and
- developmental.

This exploration will provide a framework for understanding visual perception and will focus on Foundation Phase learners and their acquisition of basic literacy and numeracy skills.

2.6.1 A cognitive approach

According to this approach, cognitive aspects develop as the individual matures (Piaget's stages of cognitive development, as cited in Cron 2006:6), and is based on the information-processing theory. Various authors (Bergh & Theron 2003:110-111; Bouwer 2004:92; Goldstein 2005:60; Gunning 2006:8-9; Loikith 1997:198; Rookes & Willson 2000:13-14; Twining 1998:127) distinguish between two processing procedures required for the process of perception. The bottom-up procedure (also referred to as *data-based processing*) is based on incoming data (the starting point) as there can be no perception if there is no incoming information. The top-down procedure (also referred to as knowledge-based processing) is based on existing knowledge. These theories arose from two leading questions (Twining 1998:128). The first question relates to how a sensation (a purely physical process) achieves perception (stimulus-driven). The second question relates to which clues or cues from the environment provide the information the brain uses to make sense of the given situation (goal-driven). Twining states that in both approaches perception is initiated by a specific moment as an individual interacts with the environment (i.e. a learner is faced with ink symbols printed on paper) and concludes with the interpretation of the experience (i.e. to decode and comprehend what is seen). Two additional approaches suggested by Twining (1998:129) are depicted in Appendix B.

The Nature approaches (nativism) focus and concentrate on man's innate abilities ('bottom-up' processing), while the Nurture approaches (empiricism) concentrate on processes based on learning and experience ('top-down' processing). Bergh and Theron (2003:110), as well as Rookes and Willson (2000:14), explain that, in the perceptual process, there is first a selection of information to which attention is given (visual attention) before there is organisation of the selected information (visual perception). Loikith (1997:198) maintains that visual perception, in all probability, involves both bottom-up (stimulus-driven) and top-down (goal-driven) processing. Figure 2.2 provides a summary of these two conceptual approaches.

Stimulus-Driven (Bottom-Up Processing)	**Goal-Driven** (Top-Down Processing)
Higher level cognitive functions	**Goals or task demands**
Perceptual processing	Knowledge and expectations
Selective attention	Strategies and procedures
Image processing	Attention allocation
Image transfer – receptors centres	Commands to ocular motor control centres
Object in the visual field	

Figure 2.2: Visual perception: Two conceptual approaches
Source: Adapted from Loikith 1997:198

Bouwer (2004:92) points out that a relationship (the underpinning and inter-relatedness) exists between the two above-mentioned processes and the two components of reading (decoding/word recognition and comprehension). In reading, the bottom-up process or also known as the part-to-whole approach is related to the decoding of printed symbols into a spoken form. The reader begins with the smallest unit (i.e. a letter, the graphic symbol and the sound) and builds up to the blending of the symbols and sounds into words, then to sentences, and ultimately the reader can gain meaning of the text (Bouwer 2004:92; Dednam 2005:140; Gunning 2006:8). The top-down process or whole-part approach of reading is a meaning-based and holistic approach. In reading the learner deals with the larger pieces of the context and the understanding (the learner's frame of knowledge) before dealing with reading at a sentence level, to then concentrating on words and lastly on individual letters (Bouwer 2004:92; Dednam 2005:140; Gunning 2006:9).

There is a tendency that a smaller number of learners will require intervention for reading, especially in the first three grades, when they are exposed to reading in a bottom-up approach (Manzo & Manzo 1995, in Bouwer, 2004:96).

2.6.2 Neurobiological approach

According to the neurobiological approach, the brain can deal with different inputs and processes simultaneously (Twining 1998:37). An interactive approach or view emphasises parallel processing of the text and the use of background knowledge. The reader will engages in simultaneous letter-sound cues, contextual as well as use of knowledge of language (Gunning 2006:9). An interactive approach, therefore, utilises three information systems, namely semantic (linguistic meaning), syntactic (rules governing sentence construction) and graphophonic (symbol-sound; (Pike 1997 in Bouwer 2004:97). This approach recognises the importance of exclusively attending to the skills involved in decoding and word recognition (Gunning 2006:9). Figure 2.3 depicts Manzo and Manzo's (1995) reconstructive/constructive model (as given in Bouwer 2004:97) as an example of an interactive approach.

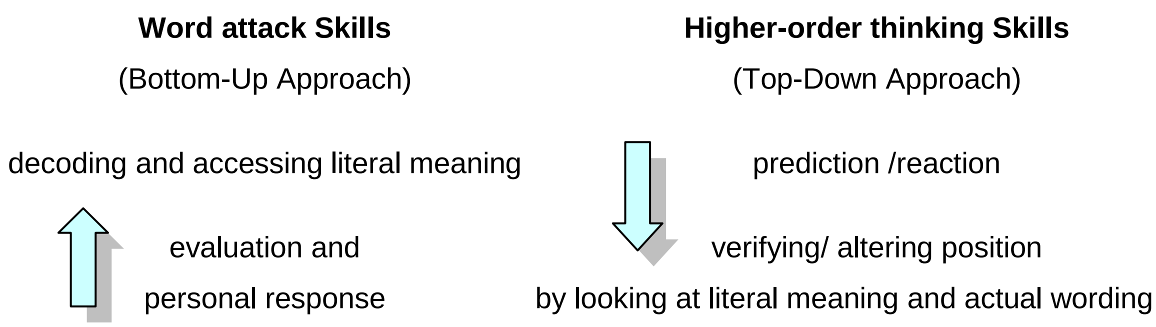


Figure 2.3: Visual perception: Two-phase process of an interactive approach
Source: Adapted from Bouwer 2004:97

Visual information is therefore processed in a parallel manner (Zecker 1991, in Gunning 2006:9 & 42). As a parallel process of visual information, visual perception facilitates the recognition (past experience and knowledge) and interpretation of the image which the eye has seen (Twining 1998:250). For instance, experienced learners use advanced *orthographic features* (the knowledge of letter patterns and relationships rather than single letters and their sound associations) to read and spell. According to Gompel, Janssen, Von Bon and Schreuder (2003:273) *orthographic knowledge* is:

> "… the general rules which underlie the correspondence between the spoken and written language and word-specific letter patterns."

The advanced learner, for example, will use the pattern and relationship of letters in the word *cape.* The learner will proceed to read the letters from left to right while simultaneously observing the final *e* to read *c/ā/pe*. The final *e* marker is used as a key to signal the sound (the vowel sound is /ā/ and not /a/). Thereby applying the appropriate rules for reading and comprehension of the word within the sentence and text (Gunning 2006:229-230).

2.6.3 A developmental approach

Development refers to the change over time in the function of the individual's structure (Bjorklund 2000:4). *Child development* is the systematic analysis of change emerging in childhood (Cron 2006:3). These systematic changes are organised and sequential (Shaffer & Kipp 2007:2). However, there exist different approaches to development. According to Cron (2006:6), Gesell's basic assumption was that development is guided by maturation of the individual's central nervous system. Piaget's theory was that development reflects changes in the way individuals acquire knowledge about the world. Skinner assumed that development is a result of the effects of learning.

Underlying developmental change therefore encompasses two important processes, namely maturation and learning. *Maturation* refers to the individual and the biological unfolding in accordance with "species-typical biological inheritance and an individual person's biology" (Shaffer & Kipp 2007:3). As a broad term, *learning* is generally defined as a relatively permanent change in behaviour due to experience (Shaffer & Kipp 2007:3; Twining 1998:466). Baddeley (1997:5) states that learning involves registering and storing information. He claims that although information is stored, the efficient use thereof is depends on accessing the correct information at the correct time. Bergh and Theron (2003:65) state that to benefit from learning or experience, the individual must have matured sufficiently. This point of development or optimal period is referred to as readiness (see section 1.2.1.4).

Consistent with the developmental approach, visual perception develops rapidly over an infant's initial six months of life (Craig & Baucum 2002:175; Smith, Cowie & Blades 1998:274). The development occurs in tandem with a succession of refinement (or fine tuning) which transpires during the first twelve years of the individual's life. The study of human development is clearly and closely intertwined with an understanding of visual perception – various aspects of visual perception mature, refine, consolidate and change as the learners develop, mature and progress academically.

2.7 THE DEVELOPMENT OF VISUAL PERCEPTUAL SKILLS

Starting at birth, the aspects of visual perception develop and are learnt through the exploration of the environment (Brockett 2006:1; Cheatum & Hammond 2000:266; Lerner 1997:318; Smith et al 1998:269; Williams 1983:73). In general, visual perceptual aspects develop rapidly and significantly from approximately three–six years of age (Kellerman & Arterberry 2006:115, 118; Williams 1983:88, 121). These aspects continue to develop, consolidate and refine until about 11 years of age (Rosner 1993:28). Although Frostig (1966, in Williams 1983:88) states that visual perception reaches an asymptote (almost reaching the peak, but not quite yet) in development at approximately nine or ten years of age.

Throughout the various stages of infancy, preschool and school years, the visual behaviour patterns of a learner develops in a "lawful" (recognisable), step-by-step sequence. Several authors (Bergh & Theron 2003:64; Brockett 2006:1; Gesell, Frances & Bullis 1949:10; Schneck 2005:418; Williams 1983:89–9) agree with this sequential pattern development.

The early research of Williams (1983:68) found various factor analytic studies (Boyd & Randle 1970; Chissom & Thomas 1971; Corah & Powell 1963; Leton 1972, as cited in Williams 1983:68) which support the notion that

> "… discrimination, integration, and memory abilities change with age and assumed different degrees of importance in the visual perception process at different points in development".

According to Williams (1983:68), visual perception is closely linked to age-related changes (see section 2.8.1). Literature also supports gender as another factor that plays a role in the development of specific visual perceptual aspects (see section 2.8.2.). Ages, at which primary visual perceptual aspects develop, is presented in Figure 2.4 (Williams 1983:89–94; Schneck 2005:418–421).

DEVELOPMENT AGES FOR EMERGENCE OF VISUAL PERCEPTUAL ASPECTS

Perception	Developmental Age		Trend of Development
OBJECT (FORM)			
Visual Form Constancy	Girls	5–8 years	improves dramatically
(Williams 1983:91–92)		9–10 years	plateaus
	Boys	5–7 years	gradual improvement
		7–9 years	slight plateau
Visual Figure-Ground	Girls	5–8 years	improves steadily
(Williams 1983:89–90)	Boys	5–7 years	great improvement
		7–8 years	slight improvement
	Both	8 years	stabilisation of growth
SPATIAL			
Position-in-Space	Both	5–6 years	same rate of development
(Williams 1983:92)		9 years	reaching plateau
Spatial Relations	Girls	up to 8 years	improvement
(Williams 1983:93–94)	Boys	5–10 years	linear trend

Figure 2.4: Developmental age and the emergence of visual perceptual aspects
Source: Adapted from Schneck 2005:419

Gibson (1997) as well as Piper and Darrah (1994), as cited in Case-Smith (2005:91) state that there are three stages through which average learners progress in learning a new skill namely, exploratory, perceptual and skill achievement. The final stage reflects a selection of action patterns that are comfortable and efficient for the learner (Case-Smith 2005:92).

At birth a number of visual-cognitive capabilities are present, but other higher-level abilities are not fully-developed or mature until adolescence (Schneck 2005:419). Therefore, as any individual develops, matures and learns through exposure to a diversity of visual environments and personal experiences, the individual's visual perceptual aspects emerge (Bateson et al 1997:73; Erhardt & Duckman 2005:138; Landsberg 2005:335; Rookes & Willson 2000:940).

2.8 DEVELOPMENTAL AND INDIVIDUALISTIC CONSIDERATIONS

When and how the perceptual abilities develop has long been a philosophical debate. According to Rookes and Willson (2000:72), nativists, at one extreme, believe individuals are born with certain perceptual abilities. Although these perceptual abilities are incomplete or immature at birth, the nativists argue that these abilities develop through a process of maturation which is genetically programmed and not reliant on learning. Empiricists, on the other extreme, believe these perceptual abilities develop through experience of the environment. Contemporary psychologists, however, are more likely to contend that these perceptual abilities stem from a combination of innate and environmental factors.

Perception is a developmental process which matures with age and experience. Each individual initially sees and pays attention to the visual sensory information before organising and interpreting the stimulus. There exists a tendency to think or assume that the perceptual experience is the same for each individual. However, Santrock (2000:128) argues that individuals may react differently to the same stimuli. Rosner (1993:27) and Scott (2003:3) agree that perception involves the interpretation of sensory information, which is reflective of an individual’s past experience and emotions. Rosner (1993:27) contends that, although two individuals see the same thing, they can perceive it differently. Therefore, a subjective approach to perception should be considered.

Rookes and Willson (2000:93) refer to several factors which can possibly contribute to different perceptual experiences:

- individual and psychological (e.g. age, gender, personality, physiological state, mood and individual life-experience)
- social and cultural (e.g. environmental conditions, cultural background and tradition).

The researcher acknowledges these various factors as valid, but due to the limited scope and principal aim of this research study, only specific factors which may be related to the Foundation Phase learner within the school environment can be addressed. There is relative consensus with regard to the role that age and gender play in the development of visual perception. These aspects will be discussed in more detail for the purpose of developing a visual perception test. These factors (age and gender) will in all likelihood impact on the test results, classification of norms and standardisation of the test.

2.8.1 Age

Children mature at different rates. Groth-Marnat (1990:163) argues that this is true for all areas of development, including the development of various visual and visual-motor perception aspects. Williams (1983:88) states that information gained from Frostig’s (1966) DTVP standardisation provides estimations for the developmental age and the emergence of specific visual perceptual aspects as depicted in Figure 2.4 (see section 2.7).

Cratty (1986:293) reports that it seems that an individual can discriminate between circles, triangles and squares from an early age (a visual discriminatory aspect). An individual can draw a circle at three years of age, a square at four years of age, a triangle at five years of age and at six years is able to copy a diamond (the skills of visual-motor integration; Carr 2004:9; Kurtz 2003:22-24). Kephart (1980, in Beery 1997:18) cautions that although the individual may have well-developed visual and motor skills, there exists the possibility that for some reason these skills may not be integrated at that specific point in time.

There is an awareness of different growth rates. As early as 1938, Bender developed guidelines for visual-motor development which were outlined by Clawson (1962, in Groth-Marnat 1990:163–164). Beery (1997:17) provided an estimated outline for normal development of visual perception:

- At the outset and all the way through until about three years of age, there is a focus ability which pays little attention to detail of the whole.
- At the ages of four and five years, there is a noticeable shift to the focus on the parts of the whole. Subsequently, the focus shifts to fine details of the parts when approaching 6 years of age.
- Approximately at nine years of age, an individual has the ability to integrate well-differentiated parts into wholes.

According to Beery (1997:17), these are estimated foci of attention. The analysis and synthesis of parts and the whole probably occur at all ages (Beery 1997:17). Schneck (2005:419) states that the perceptual abilities of discrimination and analysis are believed to develop in the following manner:

- general to specific,
- whole to part,
- concrete to abstract, and
- familiar to novel.

This sequential development has not been proven as visual development can proceed from specific to general as opposed from general to specific (Schneck 2005:419).

A research study was undertaken by Waugh and Watson (2001:183) to establish if the assumption that visual perception could be measured by tests such as Bender-Gestalt, Beery-VMI and Frostig, was valid. The study also investigated whether these tests could be used as predictors of reading achievement and whether an individual’s reading ability could be improved with visual perception training. Their research concluded that only when the participants were divided into age groups, did visual perceptual aspects have "some" predictive value in determining the reading achievements of Grade 1 readers.

2.8.2 Gender

There is a great deal of controversy regarding gender differences in any psychological process. Rookes and Willson (2000:94) argue that there is a clear demonstration of several gender differences in touch, taste and smell, but there is not such a clear-cut demonstration for vision. There are, however, relatively consistent differences in the performance of visual-spatial tasks (Bjorklund 2000:184); Bjorklund cites research undertaken by Anooshian and Young (1981); Herman, Shiraki and Miller (1985); Herman and Siegel (1978). Rookes and Willson (2000:94-95) report that the ability to visualise the rotation of objects, the accurate perceiving of complex patterns, and the detection of orientations and relationships between different stimuli are examples of visual-spatial tasks in which male learners tend to perform better than their female counterparts. Female learners perform better in tests of object location and memory (Bjorklund 2000:191). However, Bjorklund (2000:184–185) cites studies by Allen, Kirasic and Beard 1989 as well as Hazen 1982, which failed to identify any gender differences. According to Bjorklund, research studies on the influence of age differences on spatial-orientation were "robust", but that of gender differences were less so.

2.9 VISION, VISUAL PERCEPTION AND ACADEMIC COMPETENCY

Throughout the first twelve years of formal education, vision is regarded as a key element in the learning process. Approximately 80% of information is picked up (gathered) by means of the visual sense. According to Sattler and Evans (2002:368), vision facilitates the learner to:

- "... identify the qualities, attributes, colour, shapes and other features of objects;
- acquire concepts related to space, distance, sizes and other attributes of spatial relations; and
- integrate disparate elements into a coherent whole, or gestalt".

Barry and Sargent (2006:3) and Flax (2006:186) contend that as academic demands increase the need for a more fluent, automatic and efficient application of the individual's functional vision and visual information processing (a broad group of visual perceptual and cognitive skills used for extracting and organising visual information which includes aspects of visual perception) is required. They also argue that these various visual skills and visual cognitive processes become increasingly intricate and integrated. Nevertheless, during the initial stages of acquiring visual skills and cognitive processes in academic learning, these visual components and visual perception aspects play a fundamental role in laying the foundation for the individual's comfortable, confident, automatic and efficient processing of visual information.

Borsting (2006:35-36) states that there is a need to understand the development of vision as it relates to the processing of visual information, for example, when faced with an eight-year-old learner with reversal errors or a five-year-old learner's ability to accurately draw a diamond or knowing whether a six-year-old learner should use similar strategies as an eight-year-old learner to remember things. There are three aspects that assist in the evaluation of the visual system: visual acuity, vision efficiency and visual information processing (Borsting 2006:36).

According to Carey (2006:1), there are three sub–systems in the visual system, namely eye movements (to seek and hold visual stimuli), eye focusing (to define and discriminate) and eye teaming (to be able to interpret). Schneck (2005:214) explains that the entire process of visual perception can be divided into two components: the visual-receptive components and the visual-cognitive component (see sections 1.4.2 and 2.2). The reception of visual stimuli, or the visual-receptive component, is operated through the oculomotor system (Schneck 2005:414). The mental process, which involves the interpreting of visual stimuli, is known as the visual-cognitive component (Schneck 2005:414–15). Challenges can exist in either of the components, but will differ in how the learner's academic performance is influenced. There exists a "knock-on-effect" or "dominoes-effect" as visual-receptive challenges tends to influence the quality of visual information obtained for analytical processing by the visual-cognitive components (Schneck 2005:428).

The main focus of this research study is to identify the essential contents to be included in a visual perception test for South African Foundation Phase learners. The developed test will ascertain the level of functioning of the various identified aspects of visual perception in these learners. However, there is a need to first understand how the learner affords meaning to what is seen (visual perception). Neither the three processes identified by Borsting, nor the two components mentioned by Schneck, function in isolation. Warren (1993:44) contends that the integrity of the foundational skills of the visual-receptive process (visual acuity, visual fields and oculomotor control) need to be addressed before evaluating the visual-cognitive process. This is because learning quality can be severely affected. Visual challenges do tend to impact on the quality and quantity of information (either misrepresented or insufficient) sent to the central nervous system (CNS).

In summary, if aspects of visual perception are the initial cornerstones of reading, spelling, writing and mathematical proficiency (see section 1.2.1.4 and 1.2.1.6) then being able to see and utilising the various visual mechanisms and skills efficiently, are the starting points of visual perception. The researcher believes that an understanding of the visual-receptive aspects is essential before exploring the visual-cognitive functions. Owing to the limited scope of this research study, however, a brief discussion on the visual-receptive foundational aspects and functions can be found in Appendix C.

2.9.1 Visual-cognitive functions: Visual information processing

As an active process, visual perception is part of the learner's visual information processing which involves a group of perceptual and cognitive aspects necessary for extracting and organising visual information from the environment (Borsting 2006:36). The extracted and organised information is integrated with information from other sensory modalities and higher cognitive skills (Borsting 2006:43; Lane 2005:43). Glass (2002:3) states that the discrimination of patterns, visual recognition, visual memory or visual-motor integration relates to a higher order of visual processing which occurs in the primary and association areas of the cortex, as well as the involvement of sub-cortical structures and the cerebellum. The multifaceted interaction between visual processing and cognitive factors are depended and influenced by development, prior experience and motivation (Lane 2005:44).

According to Williams' early neuro-conceptual model of visual perception (1983:80-81), the well-defined structure of visual perception (explicitly all processes which encompasses the various aspects of visual perception) is multidimensional in nature. She states that at an educational (learning) and/or a behavioural (reaction) level, visual perception ordinarily includes the following three major aspects (William 1972, as cited in Williams 1983:81):

- Discrimination, which is "the ability to differentiate, to varying degrees of precision, similarities or differences in the characteristics, arrangement, sequences and/or organisation of single or groups of visual stimuli".
- Visual memory, which is "the ability to recall, with or without external help, the above characteristics of visual stimuli".
- Integration, which is "the ability to coordinate specific visual input with a specific motor output or response".

Discrimination develops first and becomes the foundation of other aspects of visual perception. Williams (1983:80–81) argues that even though visual memory is evident early within an individual's development, it continues to refine throughout several decades and is the last to become highly refined and enhanced. Craig (1997:175) contends that each next and emerging aspect of visual perception integrates with the already emerged aspects.

Each visual perceptual aspect therefore refines and enhances continuously throughout the early and middle childhood years of the individual learner's development.

2.9.1.1 Perceptual aspects and educational activities

Perception, which is efficient and effective, is a fundamental aspect for school performance (Loikith 1997:217). There is a heavy reliance on aspects of visual perception for learning to recognise and differentiate the various forms of shapes, letters, words and numbers. Mann, Suitor and Mc Clung's (1979:11–12) early classification of perceptual aspects for educational activities (the best classification found) included the following:

- The ability to notice differences and similarities between objects [visual or tactile] or sounds [auditory] (discrimination).
- The ability to pay attention to detail by comparing different shapes, sizes and colours (form constancy).
- A good short-term memory and the ability to remember the order in which objects have been seen or things heard (sequencing).
- The ability to complete an object, symbol or picture without having seen the whole image (visual closure).
- The ability to focus attention on important images or sounds (figure-ground perception). The ability to reproduce or copy what was seen (visual-motor integration).

Scott (2003:24) identifies similar perceptual (visual and auditory) aspects: discrimination, analysis, synthesis, foreground/background discrimination, closure, memory and recall as an imperative part of school readiness capabilities within the South African context.

2.9.1.2 Identifying aspects of visual perception

Within the broad scope of visual perception, various authors have identified aspects of visual perception which claim to measure the construct of visual perception. Frostig and her colleagues first developed the Developmental Test of Visual Perception (DTVP) in 1966 based on the important fact that a disturbance in visual perception was a frequent symptom of individuals with learning challenges. More significantly, they argued that visual perceptual aspects tended to play a fundamental role in the development of the learner's challenges. They identified five subtests, namely Eye-Motor Coordination, Figure Background, Constancy of Form, Position-in-Space and Spatial Relationships, as sufficient to record the various visual perceptual aspects of individual learners.

Kirk, McCarthy and Kirk (1968:9-11) revised the Illinois Test of Psycholinguistic Abilities (ITPA) and included the following subtests: Visual Reception (decoding) and Visual-Motor

Association (functions tested at the representational level). Functions tested at the automatic level included the subtest Visual Closure and Visual Sequential Memory.

Kavale's (1982:43) meta-analysis was an attempt to clarify how specific aspects of visual perception and particular reading achievements correlate (see sections 1.2.1.5 and 1.2.2.3). Kavale distinguishes the following visual perceptual aspects: visual discrimination, visual memory, visual closure, visual spatial relationships, visual-motor integration, visual association, figure-ground discrimination and visual-auditory integration. The reading skills include general reading, reading readiness, word recognition, reading comprehension, vocabulary and spelling (Kavale 1982:43). The meta-analysis findings "... suggested that visual perception is an important correlate of reading achievement" (Kavale 1982:42).

Gardiner, the author (1988:5) of the Test of Visual Perceptual Skills (non-motor–TVPS) states that the purpose of testing "the umbrella term" of visual perception is to determine the "particular strengths and/or weaknesses" of a learner's visual perceptual aspects. Seven aspects important for a comprehensive assessment of visual perception were identified in the TVPS: visual discrimination, visual memory, visual spatial relationships, visual form constancy, visual sequential memory, visual figure-ground and visual closure (Gardiner 1996:8).

Colarusso and Hammill (1996:8) selected 40 items to represent five aspects of visual perception for the Motor-Free Visual Test (MVPT-R). These aspects are visual discrimination, spatial relations, figure-ground perception, visual closure and visual memory. The aim of the test was to provide a general estimate of visual perceptual ability as opposed to identifying "… specific deficits or strengths in the sub-areas of visual perception."

Erhardt and Duckman (2005:138) state that visual perceptual processes include visual discrimination, visual memory, visual spatial relationships, form constancy, sequential memory, visual figure-ground and visual closure.

In recent literature, Schneck (2005:415-417) identifies visual-cognitive functions as having the following components: visual attention (alertness, selective attention, visual vigilance, and shared or divided attention), visual discrimination (for matching, recognition and categorisation), visual memory and visual imagery.

The group of perceptual and cognitive aspects in processing visual information comprises three categories: visual spatial (directionality and organisation of objects in space), visual analysis (form perception, visual attention, visual memory and visualisation), and visual-motor integration and copying skills (Borsting 2006:36, 43-64).

The researcher identifies the following aspects of visual perception for possible inclusion in the development of a test to adequately measures aspects of visual perception of the South African Foundation Phase learners:

- Discriminatory aspects: visual discrimination and visual form constancy
- Visual Spatial Orientation aspects: visual spatial relationships and position-in-space
- Memory aspects: visual memory and visual sequential memory
- Visual Analytical aspects: visual closure, visual figure-ground discrimination, visual analysis and visual synthesis.

Attention will be given to define these identified visual perceptual aspects as the contents for the development of a visual perception test (see section 3.4.3.1). A brief discussion on the possible implications of visual perceptual challenges impact on Foundation Phase learners' academic performance and competency follows each description.

2.10 IDENTIFIED VISUAL PERCEPTUAL ASPECTS: SKILLS AND FUNCTIONS

Processing visual information is a cognitive activity which involves aptitude (skill) and purpose (function). Perception initiates all cognition (Bjorklund 2000:159). Loikith (2005:145) explains that there is a complex connection between visual, spatial and cognitive aspects. These mentioned aspects comprise of a vast collection of automatic processes and procedures (Groffman 2006:255).

Visual perception is also a learnt process. The eyes attend to relevant details of visual stimuli, facilitate discrimination and interpret cues available in specific experience-related ways (Williams 1988:73). The process of teaching or instruction can have a direct impact on the perceptual competence of the individual learner (Lerner 1993:318). Shaywitz (2003:196) infers that it may be the teaching that is failing the learner.

2.10.1 Visual attention

Attention is a purposeful, conscious activity (Loikith 2005:146) and a process whereby visual information is extracted from the visual environment in a selective, active and efficient way (Richman 2006:122). According to Piaget (Grobecker 1992, as cited in Loikith 1997:198), information is dependent on the ability of knowing what to look at. Matlin (2002:50-51), as well as Medin, Ross and Markman (2001:50-51) contend that attention helps with the accomplishment of tasks by i) initially paring down sensory information and creating a more manageable amount for the cognitive system to process, and ii) the prevention of interference.

In learning, the learner is required to shift attention from one task to another (Scheiman & Gallaway 2006:388). Loikith (2005:153) states that all visual perception tasks involve attention shifts to spatial detail. Successful writing and reading involves attention shifts which are rapid and efficient. For example, as the learner begins to write within the lines on a page, attention is firstly given to the pencil point; the letter formation; the writing line; judging the spacing between the previous formed letter and the next letter to be formed; leaving a space between words (a more complex attention) and being aware of the edge of the paper.

According to Schneck (2005:435), aspects of visual attention are enhanced by appropriate developmental activities for learner, in conjunction with visual and tactile stimulation. Bjorklund (2000:365) states that memory, language visual attention and the perceptual discrimination abilities are basic cognitive aspects. Lerner (1993:192) describes *cognitive aspects* as a “cluster of mental skills” which is fundamental for human functioning. Visual attention therefore is essential to facilitate these basic cognitive aspects for a Foundation Phase learner within the classroom environment.

2.10.2 Visual perceptual aspects

Visual perceptual aspects are the functions and skills that facilitate discrimination, analysis and processing of visual information (Scheiman & Gallaway 2006:388). The efficient accomplishment of a visual task is facilitated by visual perceptual aspects. The basic foundational aspects enable the learner to firstly recognise shapes, letters and numbers (the individual parts) and ultimately recognise the words and figures (the wholes). Visual perceptual aspects therefore facilitate the development of literacy and mathematical concepts.

The following visual perception aspects are identified as most important for any learner within the South African context to master schoolwork: visual discrimination, form consistency (visual form constancy), visual closure, visual synthesis and analysis, visual sequence, spatial orientation, visual figure-ground perception and visual memory (Dednam 2005c:370).

2.10.2.1 Visual discrimination

Visual discrimination refers to being able “to differentiate one object from other” (Lerner 2000:271). Kavale (1982:43) refers to this visual perceptual aspect as “the ability to perceive dominant features in different stimuli”. Gardiner (1988:65) claims that “it is the ability to match or determine exact characteristics of two forms when one form is among similar forms”. Schneck (2005:415) maintains that visual discrimination is “the ability to detect features of stimuli” and identifies three abilities for this detection from the work of Bouska and her colleagues (1990 cited in Schneck 2005:415):

- *recognition* (the ability to be aware of key features and relating them to memory)
- *matching* (the ability to observe similarities among stimuli)
- *categorisation* (is the mental ability to determine the category or quality by noted differences or similarities).

Visual Discrimination is, therefore, a visual observation and awareness of two aspects of form or objects, namely similarities and differences. According to Retief and Heimburge (2006:37), this visual perceptual aspect is vital for reading, writing and mathematics. Dednam (2005c:370) and Kurtz (1997:324) refer to visual discrimination as the learner’s ability to discern differences (differentiate) between various letters, figures, numbers and/or words. For example, the learner is able to visually distinguish the number of humps of the letter ***m*** or ***n,*** or the difference between ***n*** and ***h,*** or ***1*** and ***7*****,** or ***2*** and ***5*****,** or ***12*** and ***21.*** This discernment is achieved through concentrated visual observation. There is also the awareness of similarities that involves the learner’s ability to match identical letters, numbers, designs and shapes. Woodrome (2005:1-2) found a significant association ($r=0.3$, $p<0.01$) between visual discrimination and lowercase letter identification abilities.

Lerner (2000:271), however, defines visual discrimination as the ability “to discriminate, namely by colour, shape, pattern, size, position or brightness” of form or objects that is critical in learning to read.

A learner who struggles to visually discriminate similarities or differences will not be able to distinguish between various forms. For example, such a learner (with no visual acuity challenges) will have difficulty discerning between a square and rectangle or a circle and an oval. Dednam (2005c:370) refers to the learner’s inability to differentiate between symbols (i.e. ***a*** and ***o/e*** or ***u*** and ***v***) and words (i.e. ***bad*** and ***bed*** or ***not*** and ***hot***) which look virtually similar in graphic representation.

Retief and Heimburge (2006:37) agree with this observation. Any learner, therefore, who is unable to distinguish between forms, will experience difficulty with literacy and numeracy as form perception is the basis of reading, writing, spelling and mathematics.

2.10.2.2 Visual form constancy

Visual form constancy is the ability to recognise the dominant features of forms regarding the sizes, colours, shading, textures or positions (Hamill et al 1993:2). Lerner (2000:271), however, defines visual discrimination in this manner (see section 2.10.2.1). Dednam (2005c:370) refers to *form consistency* as the learner's ability to distinguish an object "... on the basis of its form". Gardiner (1988:65) states that visual form constancy is the ability to see the form (the what) as well as locate the form (the where), irrespective of the differences in the size, spatial orientation or if it is being partially concealed (visual closure). Schneck (2005:416) agrees that object or form constancy is the ability to recognise objects or forms regardless of orientation or detail differences. Objects in the young learner's past had remained constant (a teddy bear remains a teddy bear irrespective of its spatial orientation). When learning the alphabet, however, the asymmetrical letters such as ***b, d, p*** or ***q*** challenge the young learners' past concept of constancy (Cheatum & Hammond 2000:117).

Williams (1983:105-106) states that constancy represents the stability of the perception and refers to Elkind's (1975) reference regarding constancy or invariance as an important characteristic of mature perception. Kavale (1982:44) reports a significant relationship (p<10) between reading achievement and only one of the five DTVP subtests, namely form constancy; during the meta-analysis (see section 1.2.1.4).

A learner who struggles with form constancy, for example, cannot recognise the letter ***A*** when it is presented in different ways (i.e. either typed in different fonts, written in upper or lower case, or in italics; Dednam 2005:128; Schneck 2005:416). Dednam (2005c:370) maintains that such a learner is not successful in recognising words on sight without being confused. For instance, with similar looking words such as ***where*** and ***were*** or ***pair, pare*** and ***pear*** (Gunning 2006:42). In mathematics both visual discrimination and visual from constancy challenges can manifest. Learners tend to confuse the numbers **3, 5** and **8; +** and **x;-** and ÷ (Dednam 2005b:201).

2.10.2.3 Visual spatial orientation

Visual spatial orientation refers to the individual's awareness of space around the learner in terms of form, position, distance and direction (Retief & Heimburge 2006:37; Sattler

2002:330). Aspects of visual spatial orientation allow for the development of internal and external spatial concepts to facilitate organisation of environment and interaction with it (Scheiman & Gallaway 2006:381). These component aspects are bilateral integration (awareness and use of body sides, either separately or simultaneously), laterality (left and right awareness on self), and directionality (interpreting left and right directions in three separate components of external space (see section 2.10.2.5); Dednam 2005b:198; Frederickson & Cline 2006:346; Scheiman & Gallaway 2006:381-382).

Visual spatial orientation aspects are therefore important for learner's letter formation (especially asymmetrical letters); reading direction (left to right); and the location of the new reading line (Dednam 2005c:370). The determination of direction and the relationship between objects is also important for mathematical tasks (Dednam 2005b:198). For instance, learners face challenges with place values e.g. a learner has difficulty understanding the value of ***3*** on the left of the number ***33***.

2.10.2.4 Position-in-space

Hamill et al (1993:2) refer to the discrimination of reversals and rotations of figures, forms or objects as position in space. The subtest Position in Space (DTVP) "measures the ability to match two figures according to their common feature". Within this DTVP subtest the two of discriminatory aspects of visual perception are assess, namely visual discrimination and spatial orientation.

2.10.2.5 Visual spatial-relationships

Visual spatial relationship is the ability of an individual to simply be aware of, or recognise and identify, the position or orientation of objects in two- and three-dimensional spaces (Williams 1983:104). Hamill et al (1993:2) refers to spatial relations as involving "the analysis of forms and patterns in relation to one's body and space". This ability to be aware of and to organise space is a developmental process that a learner requires (Schneck 2005:420) to function optimally within the classroom.

An important aspect in the development of an awareness of dualism and spatial opposites (i.e. in/out, top/bottom, front/back) is spatial directional mastery (Williams 1983:104). A moderately, orderly sequencing ability begins to develop at about three to four years of age and allows for vertical (**I**) to horizontal (**–**) discrimination. A six-year-old learner can discriminate between horizontal (**–**) and oblique (***/***) lines, but experiences difficulty with vertical-oblique (**I **) and oblique-oblique (***/* **) dimensions (Williams 1983:104-105; Cratty

1986:306; Schneck 2005:420). Vertical and horizontal discrimination, as well as complex oblique and diagonal dimensions should be mastered by eight years of age.

Directionality is built on the learner's "well-defined sense of laterality" and body knowledge (Cheatum & Hammond 2000:115-118). Developmentally, the learner transmits knowledge of self (their own bodies, an egocentric localisation) onto space and objects (an objective localisation; Cheatum & Hammond 2000:115). There are three directional references involved in directionality: left and right, top (up) and bottom (down), and forward (in front of) and behind (at the back of). Egocentric localisation is a gradual process and develops between the ages of six and eight. Only at ten years of age are the majority of learners able to identify the laterality (left and right) of people facing them (Cheatum & Hammond 2000:116).

The integration between the various visual perceptual aspects is essential. For instance, directionality is an important factor in visual discriminatory aspects of letters and numbers in reading, writing, spelling and mathematics (Retief & Heimburge 2006:37; Schneck 2005:420). The role of active memory also plays an important role in writing (Lokith 1997:202). It is especially visible in young learners' work. As a young learner attempts to produce certain letters or numbers from memory, the direction of the letter or number formulation may not be as significant to the learner at that particular point in time when forming the letter or number. A lack of visual spatial development in older learners (i.e. after eight years of age), however, is the main cause of reversal. The commonly used generic term, *reversal* involves a number of perceptual confusions which include: rotational or orientation errors (***b*** for ***d***), mirror images (┘ for └) and transposition error/sequence letters (***was*** for ***saw***; Gunning 2006:34). A common reason for reversing letters or numbers is the learner's inability to discriminate left from right or top to bottom. These learners usually experience directional discrimination problems due to a lack of the laterality consistency with respect to either themselves or the environment around them.

If a learner struggles with visual spatial orientation, it tends to affect his or her reading, spelling, handwriting and mathematical abilities in various ways. One common error in visual spatial relations is the incorrect and inconsistent spacing between word and number units. The learner will also experience difficulties in symbol and word reversal and/or rotation (i.e. ***b, d*** or ***p***, ***board*** or ***broad***, ***drop*** or ***prod,*** and in the number ***6*** or ***9*****;** Dednam 2005c:370). Adding and subtracting numbers may be done from left to right (e.g. ***48 + 16 = 514***) instead of right to left (e.g. ***48 + 16 = 64***).

During written assignments, the learner may demonstrate either over- or under-spacing or possible difficulty in keeping within the lines or margins during various written tasks (Schneck 2005:427). The cause for sequencing or transposition errors can be related to the manner in which the learner processes visual information. Novice readers process letter by letter (***c-a-t***) or number by number (***7-2-4-5***). Mature readers utilise letter or number patterns (***c-at*** or ***72-45***). These visual perceptual confusions, however, can also be related to visual memory (Gunning 2006:35).

2.10.2.6 Visual memory

Visual memory refers to the ability to remember what the eyes have seen. It is the ability to retain visual information or to remember (for immediate recall) the various characteristics of a given object or form (Borsting 2006:55; Sattler 2002:330). Memory is developmental and with growth individuals increase their capacity to encoding, storage and retrieval information (Gunning 2006:28). The aspect of attention ("the act or state of directing one's consciousness to stimuli"; Gunning 2006:31) is also crucial for this visual perceptual aspect. If the learners are not attentive to the visual stimuli they cannot process the visual information to recall or recognise it later (Dednam 2005c:370).

Short-term memory refers to the ability to remember something for a brief moment of time. Sousa (2001:41) states that the term short-term memory primarily includes the immediate memory and the working memory. *Immediate memory* has the capacity to hold sensory data, consciously or subconsciously, for up to 30 seconds (Schneck, 2005:415). Levine (2002:93) refers to the *active or "working memory*" where information briefly rests, yet not as abruptly as in the short-term memory or as permanently as in the long-term memory. Cornoldi and Vecchi (2003:9) argue that within cognitive psychology, the concept of working memory has acquired a crucial role:

> "Its importance resides in the fact that the human mind cannot operate without the support of a temporary memory system, holding and processing information to carry out cognitive tasks."

The working memory's functional capacity improves with age coinciding with major cognitive growth spurts. For example, preschool learners can cope adequately with two items of information; pre-adolescent learners can cope with three to seven items (five items being the average capacity). Owing to further cognitive expansion during adolescence, there is an increased functional capacity to be able to deal with five to nine items, with seven items being the average. For most individuals, this number tends to remain constant throughout their lifespan. The processes of *rehearsal* (the reprocessing of information) and *chunking* (the ability of the brain to perceive a coherent group of items as a single item or chunk) increase the number of items within the functional capacity of the working memory (Sousa 2001:287, 290). Cornoldi and Vecchi (2003:9) also argue that successes or failures in various activities could be due to an efficient or weak functioning of working memory respectively.

The ability to store what has been learnt is imperative, but so is the ability to recall it. There is an important difference between long-term memory and long-term storage. According to Sousa (2001:50), *long-term memory* refers to the process of storing and retrieving information, whereas *long-term storage* refers to where in the brain memories are kept.

The visual memory aspect assists individuals to remember what they have seen or read by adequately processing information through their short-term memory, from where it is filtered out into the long-term memory. Visual memory is the most important perceptual aspect in reading, spelling, writing and numerating. Kavale's (1982:45) meta-analysis found that visual memory exhibited the most significant association with spelling measures.

Poor visual recall occurs when the learner cannot remember what he or she has seen or read. The learner struggles to remember what the pattern of the word or numbers looks like or is unsuccessful in identifying a similar word or number combination on another page. When the learner is given letters or number combinations to build words, he or she may place them in the wrong order or leave out certain letters or numbers. It is also a challenge to remember the steps to solve mathematical problems (Dednam 2005b:201). Similarly, such a learner will not remember what he or she saw during an educational outing and will not be able to report on it either verbally or in written form.

Reading or writing is frequently whispered softly or sub-vocalised to facilitate auditory compensation. Comprehension is difficult. When this learner copies an assignment, it is unduly prolonged owing to the frequent need to reassess (the checking and rechecking) what has been copied or written.

2.10.2.7 Visual Sequential Memory

Visual sequential memory is the ability to perceive and remember forms or characters in the exact order (Groffman 2006:266). Within the classroom situation, it is the learner's ability "to recognise, recall and reproduce visually presented materials in the correct order" (Retief and Heimburge 2006:38). This visual perceptual aspect is therefore crucial, especially in reading, writing, spelling and mathematics. For instance in reading, there are high frequency words which are nonphonetic (e.g. ***of***, ***where***, ***from***, ***said***). Nonphonetic words are learnt by visual recognition, not sounding out and become automated. Kavale (1982:44) reported a significant association ($p<0.01$) between reading achievement and the visual sequential memory subtest of the ITPA. Ram-Tur, Faust and Zivotofsky (2008:448) propose that a learner's limited working memory for the retention of auditory and visual information can interfere with the recall of the correct orthographic sequence pattern of the word and its phonemes (sounds).

Learners who struggle with visual sequential memory regularly omit, add or rearrange (transpose) letters and/or numbers (see 2.10.2.6). These learners find it difficult to remember how to form the letters or numbers without having concrete examples to consult from. They tend to sub-vocalising while writing, i.e. whispering or talking to themselves (see section 2.8.4.2). The ability to recognise and remember patterns is crucial for academic learning.

2.10.2.8 Analytical visual perceptual aspects

The manipulation of visual images becomes crucial for the comparison of shapes and symbols and for developing thinking and logical reasoning skills. Analytical visual perceptual aspects entail looking at or remembering the essential features to ensure future visual construction or reconstruction (Barry & Sargent 2006b:1).

2.10.2.9 Visual analysis and synthesis

Visual analysis is the ability to break up (analyse) objects, forms and words, while *visual synthesis* is the ability to assemble parts, i.e. letters or syllables, to form words. Dednam (2005c:370) refers to the learner's ability to analyse words into its sounds and to synthesise the sounds into comprehensible words. Scheiman and Gallaway (2006:389) contend that visual processing speed is closely linked to the ability to analyse visual information.

A learner who struggles with the ability to analyse or synthesise, will experience challenges in reading, spelling, writing and mathematics. Learners frequently grapple to understand the rules which facilitate analysing words into syllables or synthesising syllables into a word (Dednam 2005c:370). This syllabification challenge affects the speed of processing. A laboured visual processing speed tends to interfere with reading automaticity, and writing or copying written tasks (Scheiman & Gallaway 2006:389).

2.10.2.10 Visual closure

Visual closure is a task that requires the individual learner to recognise or identify an object even though the total stimulus is not presented (Lerner 2000:271). Kavale (1982:43) states that it is "the ability to recognize a complete figure from fragmented stimuli". Therefore, it involves the ability to use contextual clues to visualise a complete whole when only provided with a partial picture or incomplete information. The visual closure aspect enables learners to read and comprehend swiftly. According to Dednam (2005c:370), the learner's eyes do not have to process every letter in every word to recognise the word by sight. For example the first syllables ***hip*** followed by ***po*** facilitates the reading speed as the learner anticipates the word ***hippopotamus*** without scrutinising each letter feature. Therefore, the ability to recognise or anticipate, as well as to infer, facilitates predicting outcomes through this visual perceptual aspect.

Learners with poor visual closure skills may experience challenges in reading, writing, spelling and comprehending, as well as complications in completing a thought. There is also a tendency to confuse similar objects and outcomes, especially words with close beginnings or endings.

2.10.2.11 Visual figure-ground discrimination

Visual figure-ground discrimination refers to the ability to distinguish an object or form from its surrounding background (Lerner 2000:271). The learner is able to perceive and locate a form or object within a busy field without being confused by the background or surrounding images. This aspect prevents a learner from getting lost or confused in details. For example, the learner is able to find a word on a page.

Dednam (2005b201 & 2005c:370) maintains the figure-ground aspect of visual perception facilitates the learner's ability to start reading at a specific place on a particular page without losing that specific place. She also contends that, although the learner is aware of the letters, words or lines surrounding what is currently being read, no specific attention is given to them. Loikith (2005:157) states that figure-ground tests are, in reality, attention shift tests.

A learner who experiences a challenge in this aspect of visual perception is unable to focus on the item in question and extract it from the visual background and is consequently distracted by irrelevant stimuli. This learner is easily confused by too much print on the page which affect his or her ability to concentrate, as well as influences the levels of attention (Dednam 2005c:370).

2.10.3 Visual perception challenges and comorbidity

Craig (1996:344) states that reading and writing are forms of symbolic communication which involve "attention, perception, memory, association with past knowledge and a particular context". Learners are required to learn how to code and decode information symbolically, and represent it in oral or spatial language with letters or numbers (Rosner 1993:25). One aspect of literacy development requires that the learner obtains meaning from 'marks on paper' or creates 'abstract squiggles on paper' which is meaningful (visual stimuli). *Encoding*, in reading, allows the brain to form a visual or a non-visual code of the word before storing it in the working memory. *Decoding* is the accessing of the components of the letters and then to comparing them against the target letters in the memory which allows for recognition of the word (Gunning 2006:28-29).

Lessing (1996:29–32), Retief and Heimburge (2006:37) and Santrock (2000:129–136) accentuate the following as distinguishable functions of perception: discrimination, analysis and synthesis, foreground-background discrimination, spatial relationships, memory, sequencing, closure, perceptual uniformity, as well as intrasensory and intersensory perceptual integration. They state that challenges in these functions tend to contribute to perceptual and visual information processing challenges.

There is however a growing awareness that several of the signs, symptoms and behaviours associated with certain learning challenges such as Attention Deficit Hyperactivity Disorder (ADHD), Reading Disorder (dyslexia; severe and persistent reading challenges) or Meares-Irlen Syndrome (MIS; light or scotopic sensitivity) are similar to those caused by visual dysfunction. For instance, the reversal of letters (**b**/**d**) or words (**was**/**saw**) or the "dancing" of letters, words and sentences are commonly linked to the term dyslexia (Hudson, High & Al Otaiba 2007:506). What should be considered is that aetiology is a rather complex matter and may include various factors (Education White Paper 6 2001:7; Kapp 1991:383). There is also a strong tendency toward comorbidity (the overlapping of two or more disorders). Schneck (2005:424–425) found several supportive studies:

- Fanning (1971), Duckman (1979), Scheiman (1984), as well as Ciner, Macks and Schanel-Kitsch (1991) reported high frequency of vision problems among learners with disabilities.
- Abercombie (1963) and Breakey, Wilson and Wilson (1994) found visual perceptual deficits in children with cerebral palsy.
- Hung, Fisher and Cermak (1987) found visual perceptual problems in children who, on intelligence testing, displayed significantly higher verbal scores than non-verbal scores.

- Daniels and Ryley (1991) found the incidence of visual-motor deficits higher than deficits in visual perceptual aspects in children with psychiatric disorders.

Research has shown that that the occurrence of visual perceptual challenges on a regular basis coincides with visual-motor skill challenges.

2.11 VISUAL PERCEPTION ASSESSMENT

Among the most frequently used psychometric tests are those which claim to measure visual perception. Brown et al (2003:3), Cummings et al (2003:499), Kavale (1982:44), Loikith (1997:223) and Schneck (2005:430-431) identify an extensive variety of tests used to assess visual perception. According to Loikith (1997:218-219), assessment is a multifaceted approach and the goal of the visual perception assessment is to discover what knowledge the learner brings to a visual task. This discovered knowledge directs the treatment goals (Loikith 1997:218). Brown et al (2003:3) and Warren (1993:42), however, remark that there is a lack of general consensus among assessment practitioners regarding what constitutes the most appropriate test for the identification of visual perceptual challenges.

A preliminary literature investigation, undertaken by Brown et al (2003:3), revealed that several instruments were developed and designed during 1930-1940. A minority of these instruments had insufficient documented levels of reliability and validity. In the 1960s, a number of standardised tests were generated and later followed by more defined ones. Subsequently, a number of these instruments were again revised, refined and updated in the 1990s and early 2000s. On average, the revised measurements included the following properties: reliability, validity, sensitivity to change and clinical utility.

Brown et al (2003:3) are of the opinion that despite the updated and revised measurement properties, published literature on revised tests receive insignificant attention or adequately updated published literature on the revised tests.

In a recent study, Hard et al (2004:628) emphasise the need to find tools with which to identify and assess those learners who have visual perceptual challenges that restrict their ability to meet the demands of daily life.

A variety of imported, standardised visual perceptual tests are available, each with its own unique features such as diverse designs, application, scoring and interpretation. Various tests reflect a recurrence of several of the designs within the test items. Rosner (1993:29) acknowledges that there are “good” tests, but there are also others that are perceived as such. Assessment practitioners identify the Bender-Gestalt and the Beery-VMI as the most frequently administered test. Nevertheless, by their very nature, these tests are assessment tools for determining aspects of visual-motor integration and not distinct visual perceptual aspects. Cumming et al (2003:499) state that the focus of these tests is on assessing the broader concept of visual perception and, more specifically, visual-motor perception and integration abilities, as well as the fine- and gross-motor abilities of the learner being assessed.

2.11.1 Psychological assessment relating to visual perception

According to Selznick and Blaskey (2006:418), there are four major components, which form part of a standard psycho-educational evaluation, namely: history, cognitive functioning, academic achievement and emotional functioning. These components construe that the assessment of visual perceptual aspects forms part of the learner’s cognitive functioning investigation. Regarding psychological assessments in South Africa, a nationwide survey conducted by the Human Sciences Research Council (HSRC) concluded that South Africa faced various challenges. Foxcroft et al (2004:ii) argue that among the challenges is a need for practitioners to have access to tests of a high quality to ensure that results yielded were valid and reliable. The comprehensive survey’s aim was to establish which registered psychological tests the South African professional practitioners currently use. In addition, the survey also evaluated the extent to which identified psychological tests required adaptation for the South African multicultural context and if any additional tests were required (Foxcroft et al 2004:11). The top ten tests used by educational psychologists revealed that the Bender-Gestalt (n=177, 80.8%) ranked a joint-second with the JSAIS (n=177, 80.8%) to the SSAIS-R (n=194, 88.6%). Foxcroft et al (2004:23) link this to the possible fact that assessments of learning problems forms part of the domain of child neuropsychology.

In South Africa, a test is classified as a psychological test when the purpose thereof results in the performance of a psychological act (Foxcroft, Roodt & Abrahams 2001:108). According to the Health Professions Act 56 of 1974, Section 37, a psychological act with respect to assessment is defined as:

> “the use of measures to assess mental, cognitive, or behavioural processes and functioning, intellectual or cognitive ability or functioning, aptitude, interest, emotions, personality, psychophysiological functioning, or psychopathology …” (Foxcroft & Roodt 2001:108).

Anatasi and Urbina (1997, as cited in Case-Smith 2005:246) and Rosnow and Rosenthal (1996:104) refer to *a standardised test* as one that has uniform procedures for the administration as well as the scoring thereof. The same instructions, materials and procedures are adhered to each time the test is administered to either individuals or groups. The test is scored to specific criteria available in the specific test manual.

Scheiman and Gallaway (2006:369) maintain that a standardised test's strength relates to this stringent specification of procedures, instrumentations and scoring to ensure that at different times and places, similar conditions can be duplicated. A standardised test is a measurement form that has been normed against a specific population (Sattler & Weyandt 2002:330; see section 1.4.1).

2.12 MEASUREMENTS OF VISUAL PERCEPTUAL FUNCTION

Commercially available tests which claim to measure visual perception are not standardised for the South African population and, to date, no full-scale national normative study has been undertaken to provide appropriate norms for any of these (Foxcroft et al 2004:24). Tests which claim to measure visual perception have a variety of formats that affect the learner's performance (Sattler 2002:225). A common factor in all tasks that measure visual perception is the learner's shifts of attention (Loikith 1997:153). A number of the commercially-available tests have a visual-motor integration component, either through the copying of a specific design (i.e. Bender-Gestalt) or a range of designs which increase in complexity (i.e. Beery-VMI). The learner has to place the design either in designated areas (i.e. Beery-VMI), within a dot-grid (i.e. Rosner's Test of Visual Analysis Skills (TVAS)), or a blank piece of paper (i.e. Bender-Gestalt).

The instructions of the Bender-Gestalt test permit the learner to use an eraser during the visual-motor task, while the learner may not use one during the Beery-VMI or TVAS protocol. Both the Beery-VMI and the DTVP (Frostig's revised Developmental Test of Visual Perception) have subtests with a visual-motor and a reduced motor component.

Another common feature of visual perception tests, especially if a reduced motor component is included (e.g. pointing), is either a horizontal or vertical multiple-choice format (e.g. Kent's Visual Perceptual Test (KVPT), Colarusso and Hamill's revised Motor-Free Visual Test (MVPT-3), the revised Gardiner's Test of Visual Perceptual Skills (TVPS (nm)-R); Martin's Test of Visual Perceptual Skills (TVPS-3)).

Visual perceptual tests may employ ceiling to ensure that the younger learner is not unduly over-taxed. Administration and scoring of the various tests also differ.

Schneck (2005:432) cautions that, owing to the complexity of the various tests, it is frequently unclear what the test is measuring. Therefore, there is a possibility that different kinds and levels of functions are being accessed.

2.13 CONCLUSION

In an empirical investigation, the literature study is the first phase and allows the researcher to place the study within the bigger picture of what is known (Merten 2005:88). This phase is fundamental to assist with answering the research problem and the various questions it poses. This literature study looked at visual perception through a variety of lenses to create a comprehensive framework wherein to conceptualise and operationalise the construct *visual perception*. Consideration was given to various disciplines (physiology, neurology, ophthalmology, optometry, occupational therapy, psychology and education) to gain insight into the visual system and the processing of visual information regarding Foundation Phase learners. It specifically included how visual perceptual aspects tend to contribute to visual-perceptual challenges within the classroom environment, influencing the individual learner's sense of proficiency, competence and psychological wellbeing.

Tests that measure visual perception, record the occurrence and the severity of any visual-perceptual challenge which impacts on learning, reading, spelling, writing and numeracy. To date, there is no imported test for ascertaining distinct visual perceptual skills and functioning, which has been standardised for South African Foundation Phase learners and specifically addresses the South African educational context.

Literature supports a theoretical foundation for the relationship between specific visual perceptual aspects and academic proficiency and competence. The purpose of this research study is to develop a visual perception test (with a reduced motor component) that measures distinct aspects of visual perception. The gathering of appropriate information together with the results of the visual perceptual test will facilitate the educational psychologist in making an informed decision with regard to the South African Foundation Phase learner's level of visual perceptual skills and functionality. In the subsequent chapters, the levels of an identified sample of Foundation Phase learners' visual perceptual aspects will be analysed by means of an empirical investigation.

CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This chapter introduces and discusses the research process used to develop and administer the newly designed test. As stated in Chapter 1, the objective of the empirical investigation was firstly, to develop a reliable and valid test which measures identified aspects of visual perception within the South African Foundation Phase population. Secondly, the objective was to statistically test hypotheses relating to distinct visual perceptual aspects and the fundamental academic performance of Foundation Phase learners. This chapter commences with the formulation of hypotheses with reference to basic literacy and numeracy abilities and the relationship thereof with visual perception of Foundation Phase learners.

To achieve the stated research aims, a representative sample typical of the South African Foundation Phase population was selected. In this chapter, information pertaining to the final sample and the method employed in selecting this representative sample is discussed.

The empirical investigation's primary purpose is the development of the Visual Perceptual Aspects Test (VPAT). Therefore, methods used to construct and develop the various items for each subtest of the VPAT as well as procedures adhered to during the administration of the test are discussed. Ethical standards regarding the ethical questions and issues which arose during this research study are also part of the discussion.

3.2 HYPOTHESES

Considering the literature described in Chapter 2, and the primary goal of this research study (to develop a visual perceptual test), the researcher formulated three relevant hypotheses. These hypotheses relate to aspects of visual perception that tends to influence the South African Foundation Phase learner's fundamental academic performance and competency in basic literacy and numeracy.

3.2.1 Hypothesis 1

There is a positive correlation between aspects of visual perception and the Foundation Phase learner's reading abilities.

The aspects (skills and functions) measured and identified by the Visual Perceptual Aspects Test (VPAT) are related to a learner's reading abilities. It is hypothesised that results from the assessment will correlate with the Foundation Phase learner's academic results for reading.

Rationale: Efficient intake and reproduction of visual information are considered important aspects of cognitive abilities and essential to reading advancement. Lerner (2000:323) states that aspects of visual perception are fundamental to the learning process. In the early stages of learning to read, aspects of visual perception are essential (Flax 2006:186; Korkman et al 2007:15; Rosner 1993:63; Schneck 2005:419). Therefore, a link between the Foundation Phase learner's reading abilities and aspects of visual perception can be expected.

3.2.2 Hypothesis 2

There is a positive correlation between visual perceptual aspects and the spelling and writing abilities of the Foundation Phase learner.

Aspects identified and measured by the newly designed Visual Perceptual Aspects Test (VPAT) are related to a learner's spelling and writing abilities. It is hypothesised that results from the assessment will correlate with the Foundation Phase learner's academic results for written language usage (i.e. spelling and writing).

Rationale: The same visual perceptual aspects, which interfere with the process of learning to read, also affect a learner's ability to spell and write (Flax 2006:202; Schneck 2005:419). It can, therefore, be expected that a relationship between visual perceptual aspects and written language usage exists.

3.2.3 Hypothesis 3

There is a positive correlation between the aspects of visual perception and mathematical abilities of the Foundation Phase learner.

Aspects of visual perception identified and measured by the newly designed VPAT are related to mathematical achievement of a learner. It is hypothesised that results from the assessment will correlate with the Foundation Phase learner's academic numeracy results.

Rationale: Visual perception is an important factor in mathematics. According to Groffman (2006:271), mathematical problems are not only associated with reading problems, but also with visual spatial confusion, visual processing, visual memory or visual motor association. Learners who experience persistent visuospatial problems also experience challenges and interference with learning (Dednam 2005b:201; Korkman et al 2007:175).

The assumption, therefore, is that there is a correlation between the learner's mathematical abilities and aspects of visual perception.

3.3 RESEARCH DESIGN

The purpose of this research study is twofold. Firstly, the purpose is to develop a test to assess the visual perception of Foundation Phase learners, especially those who experience reading, writing, spelling and/or mathematical challenges. Secondly, the purpose is to verify the reliability and validity of the developed test. For this reason, the implemented research design requires the use of purposeful and systematic methods, techniques and procedures for the collection of data (Babbie & Mouton 2001:161; McMillan & Schumacher 2006:22).

3.3.1 Selection of the sample

The intended sample of this research study consisted of 150 Foundation Phase learners and included 50 learners from each grade (see section 3.3.2). The parents or caregivers of each potential participant completed a parental consent form (refer to Appendix D).

The final number of participants for this study was 118 (see section 3.3.2.1).

3.3.1.1 Participants

The empirical investigation's sampling frame included participants from the following subgroups:

- The school standard:
  - Participants are learners from an English-medium school
- Language and ethnicity:
  - Participants include learners whose home language is English.
  - Participants include learners whose home language is Afrikaans.
  - Participants include learners whose home language is an African language.
  - Participants include learners whose home language is any other language other than those mentioned above.

3.3.1.2 The procedure to select the specific school and identified participants

- A decision was made to select participants who are enrolled at a government school within the Western Cape Province.
- The identified school had to be representative of an urban population within a South African context, and meet the language criteria as discussed above.
- The sample includes randomly selected participants from the Foundation Phase classes of the identified school. Fifty learners from each grade are identified to participate in the completion of the newly developed test. Although an equal number of girls and boys were anticipated, statistics available from the identified school indicated that girls outnumbered boys. The returned consent forms also reflected this uneven gender distribution (see Table 3.1).

The reason for selecting learners in the Foundation Phase is that literature highlights the following:

- Aspects of visual perception play a crucial role in the earlier stages of acquiring basic skills in literacy and numeracy.
- The phenomenon of visual perception is developmental by nature.
- During an individual’s visual perception development and maturation, various changes occur.
- A critical intervention stage for visual perceptual challenges before 12 years of age.

3.3.2 The representative sample

Participation in the research was based on informed consent (see Appendix D). Learners participated voluntarily and had the right to withdraw at any time. The final sample comprised all the Foundation Phase learners who returned a consent form that had been signed by their parents or caregivers.

Although 151 Foundation Phase learners (50 learners each from Grade 1 and 2; and 51 learners from Grade 3) completed the test, certain test protocols were not adhered to. The final number of participants used for the data analysis was 118. This was because 33 learners were unsuccessful in adhering to specific instructions for a particular subtest (i.e. Position-in-Space or Visual Spatial Relationships).

It is possible that on the day of assessment certain participants were impulsive or inattentive, or that they may have misunderstood the instructions.

3.3.2.1 Grade and gender

Table 3.1 gives the final number of participants used for the data analysis and the distribution in terms of gender and grade.

Table 3.1: The distribution of Foundation Phase learners in terms of grade and gender

Grade	Males	Females	Total
Grade 1	15	26	**41**
Grade 2	18	16	**34**
Grade 3	15	28	**43**
Total	**48**	**70**	**118**

3.3.2.2 Distribution of home languages

The participants' home languages were established in the relevant section on background information. The participants all attend the same government English-medium school in an urban area within the Western Cape Province. Table 3.2 gives the distribution of the home languages of the participants in terms of each grade. The majority of learners (92 learners) came from English-speaking homes.

Table 3.2: The distribution of home languages of Foundation Phase learners

Home language	Grade 1	Grade 2	Grade 3	Total	Percentage
English	32	29	31	92	77.97
Afrikaans	3	1	3	7	5.93
Xhosa	4	2	4	10	8.47
Zulu	0	0	1	1	0.85
Other	2	2	4	8	6.78
Total	**41**	**34**	**43**	**118**	**100**

3.3.2.3 Age

The youngest participant was six years and seven months old and the oldest participant was eleven years and six months old. The mean age for each grade was calculated and is shown in Table 3.3.

Table 3.3: The mean age of Foundation Phase learners in terms of grade

Grade	Mean Age
Grade 1	**7.41**
Grade 2	**8.33**
Grade 3	**9.58**

3.4 MEASURING INSTRUMENTS USED IN THE EMPIRICAL INVESTIGATION

Visual perception plays a fundamental role in learning. In terms of the hypotheses formulated for this research study (see section 3.2), the visual perceptual aspects and selected identified variables (academic achievements in reading, spelling, writing and mathematics) had to be assessed and measured.

To test the hypotheses, the subsequent measuring instruments were used:

- For visual perception: a newly-developed Visual Perceptual Aspects Test (VPAT)
- For academic achievement: the participants' results for literacy (reading, written language use) and numeracy for the academic year ending 30 November 2007.

3.4.1 Aspects of visual perception

A variety of instruments have been developed and refined over time and they claim to measure the construct *visual perception* (Brown et al 2003:3). The main criticism against these designed instruments relates to the inadequate documented levels of the reliability or validity. Another criticism is the limited availability of published literature on these instruments as measuring tools (Brown et al 2003:5).

In the past, psychologists have struggled to assess the cognitive functioning of learners who lack adequate language to demonstrate their abilities (Cumming et al 2003:243). For this reason, various instruments with a reduced motor component (see section 2.12) were developed to measure non-verbal visual perceptual functions (Cumming et al 2003:500). In these tests, learners typically used a reduced motor movement (i.e. to point).

Reduced motor visual perception tests also met the needs of incapacitated learners (e.g. a learner with cerebral palsy). If the individual was unable to point, the examiner would point while the individual responded in an appropriate manner, i.e. nodding (Cumming et al 2003:509). Madge (1992:3) is of the opinion that, within the South African context, learners should be granted an opportunity to demonstrate what they can do.

In light of the above-mentioned facts, a decision was made to develop a test. The visual perceptual aspects that are considered to be the core contents for developing a visual perception test are those that address the research question:

> ***What content needs to be included in a test to adequately measure the visual perceptual aspects of learners within the South African Foundation Phase?***

3.4.1.1 Visual perceptual aspects as part of the content of a visual perception test

The literature study indicated various distinct aspects of visual perception (see sections 2.9.2.2 and 2.10) and the researcher identified ten of these aspects that tend to influence a learner's ability to function appropriately within the formal classroom environment. The visual perceptual aspects are the following:

a) Visual discrimination
b) Visual form constancy
c) Visual memory
d) Visual sequential memory
e) Visual spatial relationships
f) Position-in-space
g) Visual closure
h) Figure-ground discrimination
i) Visual analysis
j) Visual synthesis.

3.4.2 The structure of the test of visual perceptual aspects

3.4.2.1 Initial considerations

The following were considered while developing the proposed test to assess and identify the visual perceptual proficiency levels of individual Foundation Phase learners:

- The selected visual perceptual forms should be basic shapes, forms or designs. Language symbols (the alphabet) should not be used. The learners should at least have been pre-exposed to the initial forms either within an informal (i.e. home) or formal (pre-school or school) setting. The forms should not be biased in respect to culture, education, language or gender. Beery (1997:99; 2006:10) selected geometric forms over other forms (alphabetic or numerical) to minimise the influences of education and culture.

- The test should not be too lengthy as there is a possibility that it may be used in conjunction with other academic assessments or psychometric tests (i.e. in an educational or psycho-educational assessment battery).
- Verbal responses should be limited and the test should be a motor-reduced assessment tool. There is an assumption that the majority of learners would perceive pointing or nodding as less threatening than to providing a verbal response.
- An initial, concrete example would help reduce any anxiety (see section 2.8.1.1) and help the learner to conceptualise what is required.
- Any person with an educational or testing background should be able to administer the test, score responses, determine the derived scores, and interpret the results.

3.4.2.2 Final structure of the Visual Perceptual Aspects Test (VPAT)

The final VPAT has the following characteristics:

- *Age:* The test was designed to be used for Foundation Phase learners ranging between five and ten years of age (see section 1.4.3).
- *Visual perceptual aspects:* The contents of the test include the following aspects to be assessed and evaluated: visual discrimination (VD), visual constancy form (VFC), visual memory (VM), visual sequential memory (VSM), visual spatial relationships (VS-R), position-in-space (P-S), visual closure (VC), visual figure-ground (VF-G), visual analysis (VA) and synthesis (VS).
- *Assessment contents:* The various identified visual perceptual aspects are divided into four sections for evaluation purposes: visual discriminatory aspects, visual memory aspects, visual spatial processing aspects, and visual perceptual analytical aspects. Each section evaluates identified aspects of visual perception, from its simplest level (visual discrimination) to more advanced visual information processing and analytical abilities. A full description of each of the four sections and its relevant subtests is provided in section 3.4.3.
- *Developed items:* Specific items for each of the ten identified aspects were developed according to each aspect's stated definition. Existing imported tests were also reviewed (see section 3.4.3). The newly developed items were given to experts in the field of visual perception and 16 items were selected for each subtest.
- *Test instructions and protocol:* The instructions and protocol of the test is clearly outlined in a document (refer to Appendix E). An explanation of the computation of raw scores as well as the conversion of raw scores to norms is also provided.

3.4.3 The development of a measuring instrument: Visual-Perception Aspects Test

The purpose of each of the four sections and the related nine subtests of the developed Visual Perceptual Aspects Test (VPAT) is discussed below. Each subtest was developed and described with regard to the item development, administration and scoring. It is important to note that existing visual perceptual tests (e.g. TVPS, DTVP, Beery-VMI) were used for the compilation of the test structure and various considerations pertaining to the item development, such as the format and time limits.

3.4.3.1 Section 1: Evaluation of visual perception discriminatory aspects

Any form or design has distinctive features. These features may include size, shape, colour and/or directional orientation of that form, shape or design. The learner's awareness of these distinctive features in any given form reflects an ability regarding the discriminatory aspects of visual perception.

Three subtests in Section 1 (namely Visual Discrimination (VD), Visual Form Constancy (VFC) and Visual Spatial Relationships (VSR)) assess and evaluate the learner's visual discriminatory aspects of visual perception. It is important to note that visual spatial relationships will be discussed in Section 3 since it is also forms part of the evaluation of visual spatial processing.

- Subtest 1, Visual Discrimination (VD), assesses and evaluates the learner's ability to merely be conscious of the similarities or differences regarding distinctive features of forms.
- Subtest 2, Visual Form Constancy (VFC), assesses and evaluates the learner's ability to discern and/or identify a form irrespective of its size, colour or positional orientation.

These subtests are identical in their construction, administration and scoring. Items are represented in a multiple-choice format (refer to Appendix E) and gradually increase in chunks or "bits" of information (see section 2.10.2.6) and complexity. The learner is first exposed to a concrete example to facilitate a clearer understanding of what is required and to minimise possible anxiety. For example, in visual discrimination (VD), Subtest 1, the learner is carefully made aware of similarities and differences using various plastic shapes and multi-sensory (visual, auditory and tactile) input.

The difference between a two-dimensional and three-dimensional form is also carefully demonstrated to the learner with a concrete example (refer to Appendix E).

Each subtest consists of 16 discrete plates that are arranged from easy to more complex forms. The learner is instructed to meticulously observe the form that is housed in a stand-alone box with a distinctive border. The learner is then instructed to find the exact same form or design in a multiple-choice selection of forms or designs.

Forms are presented in either a top-to-bottom presentation of choices or a left-to-right presentation. The first four items are intended for Grade R learners and is similar to the format employed by Beery-VMI (i.e. top-to-bottom) and the remaining 12 items intended for Grades 1–3 is similar to the format employed by Gardiner in TVPS (i.e. left-to-right). The reason for combining these two formats is that, according to literature, learners visually attend to forms or objects in a "top-to-bottom" approach in the earlier stages of visual observation. In learning to read, learners are required to read (track) from left to right.

Items available for the learner to choose from will steadily increases from two to seven items (i.e. Grade R – two items, Grade 1 – three items, Grade 2 – four items and Grade 3 – seven items). The items become more complex in nature (i.e. more details to observe and discriminate) as well as more refined in size.

The learner points to the perceived choice among a multiple-choice selection of possible responses (the reduced motor component). The test accommodates the learner who is physically unable to point (i.e. a learner with cerebral palsy or a spinal injury) who can nod his or her head in agreement when the tester points at the selected response. Every successful response is awarded one mark and the marks are added to provide a total raw score for that specific subtest. The raw score is then converted to a stanine (see section 4.5.1).

3.4.3.2 Section 2: Evaluation of visual memory aspects

Aspects which facilitate visual memory include attention, identification, recognition, visualisation and recall.

- Subtest 3, Visual Memory (VM), assesses and evaluates the learner's ability to recognise and recall visually presented stimuli. The capacity for short-term spatial memory is also assessed, as the learner is expected to not only recognise and recall the form, but also indicate whether the form has been transposed in any way.
- Subtest 4, Visual Sequential Memory (VSM), assesses and evaluates the learner's ability to distinguish and recall information, which is sequential in nature.

Both these subtests are identical in the construction, administration and scoring. The subtests consist of 16 discrete plates each presented in a multiple-choice format arranged from easy to more complicated and progressively refining in nature. The learner is instructed to look at the initial plate containing a single form and to view it within an allocated timeframe. The page with the initial plate is then turned over and the next page displays the items to choose from (refer to Appendix F). The allocated time depends on the age of the learner as well as the difficulty level of the item displayed. For example, in the VSM subtest, the allocated time will depend on the number of forms in the sequence.

The item number format is similar to that of Section 1. Scoring is the same as section one (see 3.4.3.1).

3.4.3.3 Section 3: Evaluation of visual spatial processing aspects

The learner's ability to comprehend the orientation of visual information in two- and three-dimensional space is known as visual spatial processing. This processing is complex and involves multiple, distinct, yet interrelated components (i.e. the fundamental ability to discriminate between forms, to scan, to rotate forms mentally, to analyse and to compare forms).

- Subtest 5, Visual Spatial-Relationship (VSR), assesses and evaluates the learner's ability to be conscious of a design that has been transposed in some way (i.e. inverted, rotated or mirrored), but retains its identity.
- Subtest 6, Position-in-Space (P-S), assesses and evaluates the learner's ability to be aware of his or her own body in relation to a particular seen form in space.

The construction, items development (16 discrete plates per subtest), administration and scoring are identical to that of the subtests in Section 1 (refer to Appendix E).

3.4.3.4 Section 4: Evaluation of visual analytical aspects

These subtests function on a higher level of processing visual information.

- Subtest 7, Visual Closure (VC), assesses and evaluates the learner's ability to recognise clues in the visual array and determine the final percept, without all the details being present or visible.
- Subtest 8, Visual Figure-Ground (VF-G), assesses and evaluates the learner's ability to attend to and identify a specific form while remaining conscious of the relationship between the form and the information in the background. The learner is requested to

locate and match a specific stimulus (form) embedded within a complex or distracting background.

- Subtest 9, Visual Analysis (VA) and Synthesis (VS), assesses and evaluates the learner's ability to analyse (break up) visual information, or synthesise (reassemble) visual information. The plates in this subtest alternate between VA and VS.

The construction, items development (16 discrete plates per subtest), administration and scoring are identical to the subtests in Section 1 (refer to Appendix E).

3.4.4 Academic achievement

Assessment of the learner's academic achievement primarily focuses on individually administered, norm-referenced measures (Hendry 2003:438). The assessments are developed to evaluate the basic skills of literacy and numeracy. A decision was made to use the learners' November academic results in order to assess the Foundation Phase learners' academic achievement. These results consisted of allocated marks that were calculated for specific Learning Outcomes for Literacy and Numeracy achievements during the academic year.

Various ethical issues, which arose during the research study, are dealt with in the following section.

3.5 PROCEDURE FOLLOWED DURING THE ADMINISTRATION OF THE VPAT

3.5.1. Test format

Relevant biological information that is requested from the learner:

1. Gender
2. Age
3. Home language
4. Relevant background information
5. Type of school (i.e. government or private)
6. Grade

The Visual Perceptual Aspects Test (VPAT) is divided into four sections with nine individual subtests.

3.5.2. Consent to undertake the proposed research study

The Western Cape Department of Education, the principal, the phase head of the identified school, and the parents/caregivers were approached by the researcher to obtain formal consent to proceed with the proposed research study. As previously mentioned, a convenient sampling technique was used to select the school. The researcher telephonically approached the particular school and requested permission from the school principal.

A written request was then forwarded to the Western Cape Department of Education requesting permission for research to be undertaken at the identified school. The Department of Education approved.

The venue that the researcher would use was identified. The school library was selected because of its appropriate lighting and air-conditioning. In addition, the phase head believed that the library was perceived differently by the learners, i.e. a less anxiety-provoking environment than a classroom. The library would be used for the duration of the testing, i.e. four days. An informative letter was vetted by the school and sent home to all Foundation Phase parents or caregivers (refer to Appendix D). The letter introduced the researcher, highlighted the importance of vision, visual perception and academic performance, and described what the research programme entailed. The letter also informed the parents/caregivers that the name of the school and names of parents/caregivers or the participating learners would not be made known. This addressed confidentiality and privacy concerns. Parents/caregivers were requested to provide *formal written consent* for the learners to participate in the research study.

3.5.3. Testing phase

The test was administered to no more than 12 learners at a time. Each participant was randomly placed at a separate table. The test was administered during the morning to avoid fatigue. The administration procedures were strictly followed. Although the test is designed for a reduced motor component (finger pointing or nodding), pencils and paper were used in the group setting for practical reasons.

Each participant received four booklets. Each booklet contained specific items of the ten identified visual perception aspects (refer to Appendix E). On each day of testing, the researcher was assisted by an educational psychologist.

There was no time limit imposed on the learners, except during the visual memory subtest. Owing to challenges in the administration and the level of maturity of learners, the booklet containing the visual memory and visual sequential memory subtests was not included in the final data analysis. Participants received the booklet for visual memory aspects with clear instructions to open only when told to do so. The target items were placed in a

PowerPoint presentation with the various time delays beforehand. Each target item was flashed onto the screen. Participants found it difficult to remember not to turn the page before being instructed to do so. In addition, a number of learners were also not successful in maintaining their attention or focus on the visual stimulus for the brief time period required. This attention was necessary to adequately process the visual information presented for later recall. This inability to follow the instructions, to concentrate fully on the stimulus and a tendency towards impulsivity rendered this part of the test (visual memory) invalid. The visual sequential memory subtest was also therefore discarded.

Only the remaining three booklets (visual discriminatory, visual spatial processing and visual analytical aspects) were deemed valid.

3.5.4. Processing phase

The academic results of all the participants were obtained after the final report for 2007 had been compiled at the identified school. Participants' booklets were marked. The relevant background information, the results of the responses and the academic achievements were coded to facilitate confidentiality and data being read into a computer system for analysis.

Chapter 4 contains a detailed analysis of the findings of the empirical investigation.

CHAPTER 4
INVESTIGATION RESULTS

4.1 INTRODUCTION

The objective of the empirical investigation was twofold in nature. The first objective was to develop a reliable and valid test that could be used to assess the visual perceptual aspects of South African Foundation Phase learners. The second objective was to statistically test the hypotheses which were formulated in Chapter 3 (see section 3.2). These hypotheses dealt with the relationships between identified visual perceptual aspects and basic literacy and numeracy abilities of Foundation Phase learners.

The discussion of the investigation results is also twofold. In the first section, the psychometric characteristics of the newly developed test are given. It includes the following:

- The item analysis that was conducted.
- The determination of the reliability of the test.
- The statistical analysis relating to the validity of the test.
- The calculation of norms for the different subtests of the visual perception test.

In the second section, the results of the testing of the hypotheses are discussed.

4.2 ITEM ANALYSIS OF THE VISUAL PERCEPTUAL ASPECTS TEST

Initially the newly developed test consisted of nine subtests: Visual Discrimination (VD), Visual Form Constancy (VFC), Visual Memory (VM), Visual Sequential Memory (VSM), Visual Spatial Relationships (VS-R), Position-in-Space (P-S), Visual Closure (VC), Visual Figure-Ground (VF-G), and Visual Analysis and Synthesis (VA/S). Owing to administration difficulties, the Visual Memory (VM) and Visual Sequential Memory (VSM) subtests were omitted (see section 3.5.3).

An item analysis was done for each of the seven remaining subtests. The purpose of the item analysis was to establish whether each of the items contributed to the total of a particular subtest. If an item contributed negatively to the total, that item could be left out.

An aspect that should be considered is the Alpha reliability coefficient. The Alpha reliability coefficient is calculated for each subtest for both when all the items are retained and when a specific item is left out. Based of the item-total correlation and the Alpha reliability coefficient, it is then decided whether a specific item should be retained or left out of the particular subtest.

The results of the item analysis for each of the subtests of this research study are reflected below (see Table 4.1 to 4.7).

Table 4.1: Item analysis of Visual Discrimination (VD)

No. of subjects		118
No. of items		16
Alpha reliability coefficient (all items)		0.71
Item	**Item Correlation with total**	**Alpha if item is left out**
14	0.00	0.71
15	0.00	0.71
16	0.24	0.71
17	0.05	0.71
18	0.34	0.69
19	0.37	0.69
20	0.25	0.70
21	0.36	0.69
22	0.43	0.68
23	0.38	0.69
24	0.40	0.68
25	0.28	0.70
26	0.57	0.66
27	0.33	0.69
28	0.37	0.69
29	0.33	0.69

According to the information in Table 4.1, items 14, 15 and 17 made no contribution to the total of the subtest and were, subsequently, discarded. With these items omitted, the Alpha reliability coefficient for the Visual Discrimination (VD) subtest increased from 0.71 to 0.72.

The total number of items retained for the Visual Discrimination (VD) subtest was 13.

Table 4.2: Item analysis of Visual Form Constancy (VFC)

No of subjects	118	
No of items	16	
Alpha reliability coefficient (all items)	0.48	
Item	**Item correlation with total**	**Alpha if item is left out**
30	0.10	0.48
31	0.07	0.48
32	0.10	0.47
33	0.11	0.47
34	0.14	0.47
35	0.07	0.47
36	0.33	0.52
37	0.19	0.41
38	0.21	0.46
39	0.10	0.45
40	0.14	0.48
41	0.26	0.47
42	0.25	0.44
43	0.24	0.44
44	0.11	0.44
45	0.23	0.44

Table 4.2 reflects an Alpha reliability coefficient of 0.48 for the Visual Form Constancy (VFC) subtest. This subtest does not seem to be reliable. Even when identified items were omitted, the Alpha reliability coefficient did not change significantly. It was, therefore, decided to exclude this subtest from the Visual Perceptual Aspects Test (VPAT).

There are various possible reasons for the subtest having been inconsistent and unsuccessful. Firstly, it is possible that the instructions were not clear enough to be interpreted accurately by the test participants. Secondly, the test items may have been too difficult as the cognitive development of the majority of the participants were at a concrete stage. Research has shown that form constancy is an indicator of mature visual perception. A third possible reason, therefore, may be that this sample group's visual perceptual discriminatory aspect of visual form constancy was as yet not developed.

Table 4.3: Item analysis of Visual Spatial Relations (VS-R)

No. of subjects	118	
No. of items	16	
Alpha reliability coefficient (all items)	0.80	

Item	Item correlation with total	Alpha if item is left out
78	0.00	0.80
79	0.23	0.80
80	0.00	0.80
81	0.33	0.80
82	0.32	0.79
83	0.49	0.79
84	0.50	0.78
85	0.45	0.79
86	0.53	0.78
87	0.37	0.80
88	0.54	0.78
89	0.54	0.78
90	0.52	0.78
91	0.60	0.77
92	0.61	0.77
93	0.28	0.80

Items 78 and 80 in Table 4.3 do not show any correlation with the total of the Visual Spatial Relationships (VS-R) subtest. These items were subsequently discarded because they make no contribution to this particular subtest. After discarding these two items, the Alpha reliability coefficient for the VS-R subtest changed from 0.80 to 0.81.

A total of 14 items were retained for the Visual Spatial Relationships subtest.

Table 4.4: Item analysis of Position-in-Space (P-S)

No. of subjects		118
No. of items		16
Alpha reliability coefficient (all items)		0.84
Item	**Item correlation with total**	**Alpha if item is left out**
94	0.05	0.84
95	0.10	0.84
96	0.25	0.84
97	0.36	0.83
98	0.41	0.83
99	0.50	0.85
100	0.66	0.82
101	0.66	0.82
102	0.46	0.83
103	0.57	0.82
104	0.39	0.83
105	0.50	0.83
106	0.66	0.82
107	0.56	0.82
108	0.60	0.82
109	0.40	0.83

As seen in Table 4.4, item 94 correlates low with the total of the Position-in-Space (P-S) subtest, and was subsequently omitted from the final test. Although this item was omitted, the Alpha reliability coefficient for this particular subtest showed no significant change and remained 0.84.

The total number of items retained for the subtest Position-in-Space (P-S) subtest was 15.

Table 4.5: Item analysis of Visual Closure (VC)

No. of subjects		118
No. of items		16
Alpha reliability coefficient (all items)		0.74
Item	**Item correlation with total**	**Alpha if item is left out**
110	0.54	0.72
111	0.48	0.72
112	0.52	0.72
113	0.54	0.72
114	0.26	0.73
115	0.30	0.73
116	0.32	0.73
117	0.52	0.71
118	0.31	0.73
119	0.48	0.71
120	0.33	0.73
121	0.37	0.72
122	0.27	0.73
123	0.31	0.73
124	0.29	0.73
125	0.22	0.73

Table 4.5 indicates that no item correlates low or negatively with the total of the Visual Closure (VC) subtest.

Therefore, all items were retained in the final subtest.

Table 4.6: Item analysis of Visual Figure-Ground (VF-G)

No. of subjects		118
No. of items		16
Alpha reliability coefficient (all items)		0.79
Item	**Item correlation with total**	**Alpha if item is left out**
126	0.28	0.79
127	0.05	0.80
128	0.39	0.78
129	0.35	0.79
130	0.53	0.77
131	0.34	0.79
132	0.49	0.78
133	0.47	0.78
134	0.56	0.77
135	0.41	0.78
136	0.47	0.78
137	0.55	0.77
138	0.38	0.78
139	0.30	0.79
140	0.35	0.79
141	0.24	0.80

According to the information reflected in Table 4.6, only item 127 correlates low or negatively with the total of the Visual Figure-Ground (VF-G) subtest. Subsequently, item 127 was omitted from the final test. After this item was omitted, the Alpha reliability coefficient for the VF-G subtest changed from 0.79 to 0.80.

Therefore, 15 items were retained in the final the Visual Figure-Ground subtest (VF-G).

Table 4.7: Item analysis of Visual Analysis and Synthesis (VA/S)

No. of subjects	118	
No. of items	16	
Alpha reliability coefficient (all items)	0.70	
Item	**Item correlation with total**	**Alpha if item is left out**
142	0.02	0.71
143	0.34	0.68
144	0.31	0.68
145	0.30	0.68
146	0.38	0.67
147	0.23	0.69
148	0.41	0.67
149	0.34	0.68
150	0.43	0.66
151	0.25	0.69
152	0.29	0.68
153	0.25	0.69
154	0.47	0.66
155	0.39	0.67
156	0.11	0.70
157	0.32	0.70

According to Table 4.7, only item 142 correlates low with the total of the Visual Analysis and Synthesis (VA/S) subtest. Subsequently, this item was excluded from the final test. After excluding this item, the Alpha reliability coefficient for the Visual Analysis and Synthesis (VA/S) subtest changed from 0.70 to 0.72.

The number of items retained for the Visual Analysis and Synthesis (VA/S) subtest was 15.

4.3 RELIABILITY OF THE VISUAL PERCEPTUAL ASPECTS TEST (VPAT)

Reliability refers to the degree of confidence regarding the results of a measuring instrument (Cohen, Manion & Morrison 2007:432). The Alpha reliability coefficient measures internal consistency and provides a coefficient of reliability. (Cohen et al 2007:506). The measure of *inter-item consistency* (the degree of correlation among all the items of a subtest) can be calculated from a single administered test (Cohen & Swerdlik 2002:135). As a result, a single administration of the Visual Perceptual Aspects Test (VPAT) was used to determine the reliability thereof.

With the aim of determining the reliability for the newly developed VPAT, Cronbach Alpha reliability coefficients were calculated for each subtest after specific items were discarded, as explained in section 4.2. The final, calculated Cronbach Alpha reliability coefficients for each subtest are given in Table 4.8.

Table 4.8: Reliability

VPAT Subtest	**No of items***	**Cronbach Alpha Reliability Coefficient***
Visual Discrimination (VD)	13	0.72
Visual Spatial Relationships (VSR)	14	0.81
Position-in-Space (P-S)	15	0.84
Visual Closure (VC)	16	0.74
Visual Figure-Ground (VF-G)	15	0.80
Visual Analysis and Synthesis (VA/S)	15	0.72

N = 118

*Excludes items that correlated low or contributed negatively to the total of the subtests

The following, as set out in Table 1 of the Appendices of Statistical Tables (Cohen et al 2007:506), are guidelines for the Alpha reliability coefficients:

> 0.90	very highly reliable
0.80–0.90	highly reliable
0.70–0.79	reliable
0.60–0.69	marginal/minimally reliable
< 0.60	unacceptably low reliability

The closer the Alpha reliability coefficient is to 1, the higher the reliability of the test. As seen in Table 4.8, each subtest yielded an Alpha reliability coefficient of between 0.72 (reliable) and 0.84 (highly reliable).

The results, therefore, conclude that the subtests of the Visual Perceptual Aspects Test (VPAT) can be deemed reliable.

4.4 VALIDITY

Validity relates to the extent in which the test measures what it is supposed to measure (Cohen et al 2007:423). The validity of the VPAT is based on both content and construct validity.

4.4.1 Content validity

The following measures were taken to ensure content validity:

- The construction of the content (i.e. the instructions) and items (target blocks with multiple choice options) was based on various related sections of similar international, commercially available tests. The Visual Synthesis and Analysis (VS/A) subtest is the only exception as similar international tests could not be traced.
- The items were developed according to each subtest's definition.
- The original items were referred to recognised experts in the field. The items were then altered, replaced or accepted based on their recommendations.

4.4.2 Construct Validity

It regularly transpires that a test measures different aspects of a construct. The VPAT is an example as it measures six aspects of visual perception, namely visual discrimination, visual spatial relationships, position-in-space, visual closure, visual figure-ground as well as visual analysis and synthesis. These six visual perceptual aspects are, therefore, related and it was presumed that there would be significant positive correlations between them. The test could be considered construct valid if such correlations exist.

For this reason, Pearson Product-Moment correlations were calculated between the scores of the six visual perceptual aspects subtests. All the correlations are significantly positive on the 1% level. Table 4.9 reflects the calculated correlation coefficients.

The various subtests related positively to one another and for this reason the test could be considered construct valid.

The highest correlation (0.66) is between the Position-in-Space subtest and the Visual Closure subtest. This high correlation can be explained by the fact that any form or shape has a spatial position in relation to the position of the individual. When a learner analyses an incomplete form or shape, he or she allocates attention to the spatial position of the form in relation to him- or herself and compares this to possible similar previous real life experiences, enabling him or her to complete the form or shape.

Table 4.9: Correlation between the different subtests of the VPAT

	Visual Discrimination	Visual Spatial Relationships	Position-in-Space	Visual Closure	Visual Figure-Ground	Visual Analysis and Synthesis
Visual Discrimination	1.00					
Visual Spatial Relationships	0.44	1.00				
Position-in-Space	0.50	0.43	1.00			
Visual Closure	0.46	0.40	0.66	1.00		
Visual Figure-Ground	0.46	0.40	0.59	0.62	1.00	
Visual Analysis and Synthesis	0.42	0.53	0.60	0.60	0.64	1.00

For all the correlation coefficients p < 0.0001

The lowest positive correlations are between the Visual Spatial Relationships subtest and the Visual Closure subtest (0.40) and Visual Figure-Ground subtest (0.40), respectively. These moderate correlations are due to the fact that the actual spatial presentation (i.e. inverted, rotated) of a form has a slight or no relationship with the ability to determine an incomplete form or to locate an embedded form against background information.

4.5 DETERMINING OF NORMS OF THE VPAT

An objective standard frequently used to interpret the individual's raw scores on a measuring instrument, is known as a norm. In this research study, stanines (standard scores which have been grouped into nine categories) were used to determine the norms (see Table 4.10).

Table 4.10: Limits and areas of stanines

Stanines	Limits	Percentage of area
9	+∞ to +1.75z	4
8	+1.75z to +1.25z	7
7	+1.25 to +0.75	12
6	+ 0.75 to +0.25z	17
5	+ 0.25 to -0.25z	20
4	-0.25 to -0.75z	17
3	-0.75 to -1.25z	12
2	-1.25 to -1.75z	7
1	-1.75z to -∞	4

Source: Mulder 1996:205

To calculate the stanines, the cumulative percentages of the raw scores for each subtest were obtained. Mindes (2003:99) and Mulder (1996:205) state that as a general rule, the top three stanines (7, 8 and 9) are regarded as above average, the middle three stanines (4, 5 and 6) are average, while the bottom three stanines (1, 2 and 3) are below average.

The cut-off point for each of the three groups (i.e. above average, average and below average) was determined by means of cumulative percentages (see Tables 4.11-4.16). As the test consisted of between 13 and 16 items, the raw scores were classified into the three groups using the cumulative percentages as follows:

- Above average (77–100%)
- Average (24–76%)
- Below average (0–23%).

The classifications of scores of the visual perceptual aspects are displayed in Tables 4.29-4.31. The results show that there seems to be an insignificant difference between boys and girls regarding the ability to perceive visual stimuli (See Appendix G). Hence, there are no separate norms for boys and girls in this research study.

4.5.1 Transformation of raw scores into stanines

Grade norms were developed by administering the test to representative samples of learners over a range of consecutive grade-levels.

Tables 4.11 to 4.28 reflect the stanines that were obtained.

Table 4.11: Grade 1 – Transformation of raw scores into stanines: Visual Discrimination

Raw score	Frequency	Cumulative %	Stanine
2	2	4.88	2
4	3	12.20	3
5	1	14.63	3
6	3	21.95	3
7	5	34.15	4
8	2	39.02	4
9	9	60.98	6
10	8	80.49	7
11	7	97.56	9
12	1	100	9

Table 4.12: Grade 1 – Transformation of raw scores into stanines: Visual Spatial Relationships

Raw score	Frequency	Cumulative %	Stanine
6	2	4.88	2
7	5	17.07	3
8	1	19.51	3
9	9	41.46	5
10	6	56.10	5
11	1	58.10	5
12	6	73.17	6
13	6	87.80	7
14	5	100	9

Table 4.13: Grade 1 – Transformation of raw scores into stanines: Position-in-Space

Raw score	Frequency	Cumulative %	Stanine
1	1	2.44	1
2	1	4.88	2
3	3	12.20	3
4	3	19.51	3
5	1	21.95	3
6	3	29.27	4
7	1	31.71	4
8	2	36.59	4
9	3	43.90	5
10	2	48.78	5
11	3	56.10	5
12	7	73.10	6
13	6	87.70	7
14	5	100	9

Table 4.14: Grade 1 – Transformation of raw scores into stanines: Visual Closure

Raw score	Frequency	Cumulative %	Stanine
0	1	2.44	1
1	1	4.88	2
2	1	7.32	2
4	2	12.20	3
6	1	14.63	3
7	5	26.83	4
8	3	34.15	4
9	4	43.90	5
10	9	65.68	6
11	8	85.37	7
12	3	92.68	8
13	2	97.56	9
15	1	100	9

Table 4.15: Grade 1 – Transformation of raw scores into stanines: Visual Figure-Ground

Raw score	Frequency	Cumulative %	Stanine
1	1	2.44	1
2	2	7.32	2
3	2	12.20	3
4	4	21.95	3
5	3	29.27	4
6	6	43.90	5
7	2	48.78	5
8	6	63.41	6
9	3	70.73	6
10	4	80.49	7
11	3	87.80	8
12	4	97.56	9
13	1	100	9

Table 4.16: Grade 1 – Transformation of raw scores into stanines: Visual Analysis and Synthesis

Raw score	Frequency	Cumulative %	Stanine
1	1	2.44	1
2	2	7.32	2
3	3	14.63	3
5	1	17.07	3
6	5	29.27	4
7	12	58.54	5
8	8	78.05	7
9	5	90.24	8
10	1	92.68	9
11	2	97.56	9
12	1	100	9

Table 4.17: Grade 2 – Transformation of raw scores into stanines: Visual Discrimination

Raw score	Frequency	Cumulative %	Stanine
4	1	2.94	1
5	1	5.88	2
6	1	8.82	2
7	4	20.59	3
8	2	26.47	4
9	4	38.24	4
10	7	58.82	5
11	6	76.47	6
12	4	88.24	7
13	4	100	9

Table 4.18: Grade 2 – Transformation of raw scores into stanines: Visual Spatial Relationships

Raw score	Frequency	Cumulative %	Stanine
1	1	2.94	1
2	2	8.82	2
5	1	11.76	3
6	1	14.71	3
7	1	17.65	3
9	2	23.53	4
10	3	32.35	4
11	6	50.00	5
12	7	70.59	6
13	8	94.12	8
14	2	100	9

Table 4.19: Grade 2 – Transformation of raw scores into stanines: Position-in-Space

Raw score	Frequency	Cumulative %	Stanine
7	1	2.94	1
8	1	5.88	2
9	4	17.65	3
10	2	23.3	4
11	1	26.47	4
12	3	35.29	4
13	7	55.88	5
14	10	85.29	7
15	5	100	9

Table 4.20: Grade 2 – Transformation of raw scores into stanines: Visual Closure

Raw score	Frequency	Cumulative %	Stanine
8	1	2.94	1
9	5	17.65	3
10	10	47.06	4
11	7	67.65	6
12	4	79.41	7
13	2	85.29	7
14	3	94.12	8
15	1	97.06	9
16	1	100	9

Table 4.21: Grade 2 – Transformation of raw scores into stanines: Visual Figure-Ground

Raw score	Frequency	Cumulative %	Stanine
5	2	5.88	2
6	3	14.71	3
7	4	26.47	4
8	5	41.18	5
9	2	47.06	5
11	3	55.88	5
12	7	76.47	6
13	4	88.24	7
14	2	94.12	8
15	1	97.06	9
16	1	100	9

Table 4.22: Grade 2 – Transformation of raw scores into stanines: Visual Analysis and Synthesis

Raw score	Frequency	Cumulative %	Stanine
4	2	5.88	2
5	2	11.76	3
7	2	17.65	3
8	9	44.12	5
9	7	64.71	6
10	3	73.53	6
11	5	88.24	7
12	3	97.06	9
15	1	100	9

Table 4.23: Grade 3 – Transformation of raw scores into stanines: Visual Discrimination

Raw score	Frequency	Cumulative %	Stanine
3	11	2.33	1
6	2	6.98	2
7	4	16.28	3
8	2	20.93	3
9	6	34.88	4
10	4	44.19	5
11	9	65.12	6
12	11	90.70	9
13	4	100	9

Table 4.24: Grade 3 – Transformation of raw scores into stanines: Visual Spatial Relationships

Raw score	Frequency	Cumulative %	Stanine
9	1	2.33	1
10	9	23.26	4
11	4	32.56	4
12	6	46.51	5
13	14	79.07	8
14	9	100	9

Table 4.25: Grade 3 – Transformation of raw scores into stanines: Position-in-Space

Raw score	Frequency	Cumulative %	Stanine
9	1	2.33	1
10	1	4.65	2
11	4	13.95	3
12	9	34.88	4
13	8	53.49	5
14	11	79.07	7
15	9	100	9

Table 4.26: Grade 3 – Transformation of raw scores into stanines: Visual Closure

Raw score	Frequency	Cumulative %	Stanine
8	4	9.30	2
9	2	13.95	3
10	8	32.56	4
11	11	58.14	5
12	9	79.07	7
13	4	88.37	7
14	3	95.35	8
15	1	97.67	9
16	1	100	9

Table 4.27: Grade 3 – Transformation of raw scores into stanines: Visual Figure-Ground

Raw score	Frequency	Cumulative %	Stanine
5	1	2.33	1
6	4	11.63	3
7	4	20.93	3
8	3	27.91	4
9	5	39.53	4
10	1	41.86	5
11	4	51.16	5
12	7	67.44	6
13	5	79.07	7
14	3	86.05	7
15	5	97.67	9
16	1	100	9

Table 4.28: Grade 3 – Transformation of raw scores into stanines: Visual Analysis and Synthesis

Raw score	Frequency	Cumulative %	Stanine
3	1	2.33	1
6	4	11.63	3
7	3	18.60	3
8	9	39.53	4
9	9	60.47	6
10	5	72.09	6
11	2	76.74	6
12	4	86.05	7
13	3	93.02	8
14	3	100	9

4.5.2 Classification of scores for Visual Perceptual Aspects

The classification of the scores for each Foundation Phase grade is specified in Tables 4.29–4.31.

Table 4.29: Classification of scores for Visual Perceptual Aspects – Grade 1

Visual Perceptual Aspects	Below Average	Average	Above Average
Visual Discrimination (VD)	0–6	7–10	11–13
Visual Spatial Relationships (VS-R)	0–8	9–12	13–14
Position-in-Space (P-S)	0–5	6–12	13–15
Visual Closure (VC)	0–6	7–10	11–16
Visual Figure-Ground (VF-G)	0–4	5–10	11–16
Visual Analysis & Synthesis (VA/S)	0–5	6–8	9–15

Table 4.30: Classification of scores for Visual Perceptual Aspects – Grade 2

Visual Perceptual Aspects	Below Average	Average	Above Average
Visual Discrimination (VD)	0–7	8–11	12–13
Visual Spatial Relationships (VS-R)	0–9	10–12	12–14
Position-in-Space (P-S)	0–10	11–13	14–15
Visual Closure (VC)	0–9	10–12	13–16
Visual Figure-Ground (VF-G)	0–6	7–12	13–16
Visual Analysis & Synthesis (VA/S)	0–7	8–10	11–15

Table 4.31: Classification of scores for Visual Perceptual Aspects – Grade 3

Visual Perceptual Aspects	Below Average	Average	Above Average
Visual Discrimination (VD)	0–8	9–11	12–13
Visual Spatial Relationships (VS-R)	0–9	10–13	14
Position-in-Space (P-S)	0–11	12–14	15
Visual Closure (VC)	0–9	10–12	13–16
Visual Figure-Ground (VF-G)	0–7	8–14	15–16
Visual Analysis & Synthesis (VA/S)	0–7	8–11	12–15

From the classification of the scores in Tables 4.29–4-31, a higher score reflects that a specific aspect of visual perception tends to be more refined and consolidated within that particular Foundation Phase learner.

4.6 TESTING OF HYPOTHESES

In order to test the formulated hypotheses stated in section 3.2, null hypotheses were formulated and tested statistically.

4.6.1 Testing of hypothesis 1

With regard to hypothesis 1, in section 3.2.1, the following null hypothesis was tested:

> *There is no significant positive correlation between visual perceptual aspects and the Foundation Phase learner's reading abilities.*
>
> This hypothesis was stated for each grade.

All 118 participants were used to test this null hypothesis. Grade 1 represents 41 learners, Grade 2 represents 34 learners and Grade 3 represents 43 learners (see Table 3.1).

In order to test the null hypothesis, the correlation coefficients between each of the aspects of visual perception and achievement in reading abilities for each grade were calculated.

The results appear in Table 4.32.

Table 4.32: Correlations between aspects of visual perception and reading abilities for each Foundation Phase grade

Grade	Visual Discrimination	Visual Spatial Relationships	Position-in-Space	Visual Closure	Visual Figure-Ground	Visual Analysis & Synthesis
Gr 1	0.58*	0.32**	0.33**	0.0002	0.33**	0.23
Gr 2	0.17	0.35**	0.096	0.04	0.006	0.40**
Gr 3	0.22	0.006	0.25	0.15	0.22	0.41*

* $p < 0.01$

** $p < 0.05$

For all the other correlations $p > 0.05$

From the above results it seems that the null hypothesis for Grade 1 can be rejected for all the aspects of visual perception except Visual Closure and Visual Analysis and Synthesis as these correlations are insignificant (r=0.0002; $p > 0.05$ and r=0.23; $p > 0.05$).

The aspect correlating the highest with the reading abilities of Grade 1 learners was the Visual Discrimination aspect (r=0.58; p<0.01). This is not surprising as visual discrimination is the initial foundational stone to visual perception. Visual discrimination is, therefore, the dominant aspect that is utilised by the learner at this stage. In this grade, reading is formally introduced as a new set of discriminatory abilities are being developed, such as the identification of lowercase letters. This result corresponds with the findings of Kavale's meta-analysis (1982:43) which found that visual discrimination was significantly related to reading achievement. The study reported that visual discrimination accounted for 16% of the variance in reading ability. The study of Woodrome (2005:1-2) also reported a significant correlation (r=0.3; p<0.01) between visual discrimination and lowercase letter identification.

Furthermore, three aspects, namely Position-in-Space (r=0.3; p<0.05), Visual Figure-Ground (r=0.3; p<0.05) and Visual Spatial Relationships (r=0.3; p<0.05), accounted for low positive correlations with the Grade 1 learner's reading abilities. The reason for this may be that these aspects are reaching developmental maturity (see Fig 2.4), but are still being further refined and consolidated at this stage. It is thus expected that there should be a moderate correlation between these visual perceptual aspects and the developing ability to read.

From the Grade 2 learners' results, the null hypothesis can only be rejected for the Visual Spatial Relationships and Visual Analysis and Synthesis aspects. Visual Spatial Relationship ($r=0.35$; $p<0.05$) and Visual Analysis and Synthesis ($r=0.4$; $p<0.01$) aspects yielded low and moderate positive correlations respectively with the reading achievements of Grade 2 learners.

At their age, 8–9 years, the Visual Spatial Relationships aspect is stabilising while the importance of Visual Analysis and Synthesis is increasing. During this stage, visual discrimination as the basic aspect is automated. These results reflect a change in the importance of the aspect of visual discrimination in Grade 1 to the more abstract aspects of Visual Spatial Relationships and Visual Analysis and Synthesis in Grade 2. Therefore, if the trend is reliable, a prominent correlation between the learner's reading ability and aspects of visual analysis and synthesis can be expected.

From the results in Table 4.32, it seems that the null hypothesis for Grade 3 can only be rejected for Visual Analysis and Synthesis. The correlation is positively significant ($r=0.41$; $p<0.01$).

Visual Analysis and Synthesis showed a significant moderate positive correlation with the reading abilities of Grade 3 learners. The development of all visual perceptual aspects, except Visual Analysis and Synthesis, reaches maturity at this age. Visual analysis and synthesis emerges as the primary visual perceptual aspect for learners of this grade. With the majority of visual perceptual aspects reaching a mature level and consolidation stage, it is to be expected that the aspect of visual analysis and synthesis becomes critical in the visual perceptual abilities as attending to and recognition of characters (namely words and sentences) transpires into the understanding and comprehending of text.

4.6.2 Testing of hypothesis 2

With regard to hypothesis 2, as stated in section 3.2.2, the subsequent null hypothesis was tested:

> *There is no significant positive correlation between visual perceptual aspects and the Foundation Phase learner's spelling and writing abilities.*
>
> This hypothesis was stated for each grade.

In order to test the null hypothesis, the correlations between all 118 participants' spelling and writing abilities and the subtests for visual perception were calculated. The results appear in Table 4.33.

Table 4.33: Correlations between aspects of visual perception and spelling as well as writing abilities for each Foundation Phase grade

Grade	Visual Discrimination	Visual Spatial Relationships	Position-in-Space	Visual Closure	Visual Figure-Ground	Visual Analysis & Synthesis
Gr 1	0.34**	0.18	0.17	0.08	0.22	0.17
Gr 2	0.18	0.37**	0.19	0.04	0.06	0.29
Gr 3	0.23	0.14	0.41*	0.23	0.22	0.42*

* $p < 0.01$

** $p < 0.05$

For all other correlations $p > 0.05$

It is seen from the above results that the null hypothesis for Grade 1 can only be rejected for Visual Discrimination. The results show a low correlation between Visual Discrimination (r=0.34, p<0.05) and the spelling and writing achievements of Grade 1 learners. Grade 1 learners are at the introductory stage of learning new graphomotor skills and orthographic processing (Rief & Heimburge 2006:80). Therefore, the ability to discern between similarities or differences in letter formation is one of the aspects which tend to influence spelling and writing achievement in Grade 1.

From the Grade 2 results in Table 4.33, it seems that the null hypothesis can only be rejected for Visual Spatial Relationships. Only Visual Spatial Relationships (r=0.37, p<0.05) shows a low significant correlation with the Grade 2 learners' ability to spell and write. One important aspect of spelling and writing accomplishment in Grade 2 is the learner's ability to refine and consolidate discriminating asymmetrical letters, as well as understand the meaning between them (i.e. ***b***-***d*** and ***p***-***q***).

From the results for Grade 3 in Table 14.33 it seems that the null hypothesis can only be rejected for Position-in-Space and Visual Analysis and Synthesis. This is based on a significant moderate positive correlation between the Grade 3 learner's abilities in spelling and writing, and Visual Analysis and Synthesis (r=0.42; p<0.01), and Position-in-Space (r=0.41; p<0.01) respectively.

Visual perceptual aspects facilitate the breaking down of the visual image to identify and cognitively map out structural components (the feature identification: the *what*); as well as its spatial interrelationships (the spatial orientation: the *where*).

In conclusion, the findings seem to be in agreement with Kavale's meta-analysis (1982:43), which found that visual perception accounts for a mere 15% of the variance in spelling abilities. There is also a shift from visual discrimination (letter feature identification) to a more *spatial capability* (the physical positioning of letters) when it comes to spelling and writing.

4.6.3 Testing of hypothesis 3

With regard to hypothesis 3, as stated in section 3.2.3, the following null hypothesis was tested:

> *There is no significant positive correlation between visual perceptual aspects and the mathematical abilities of the Foundation Phase learner.*
>
> This hypothesis was stated for each grade.

In order to test the null hypothesis, the correlations between each visual perceptual aspect and the achievement in mathematical abilities for each grade were calculated. In testing this null hypothesis all 118 participants were used (see section 4.7.1). The results are reflected in Table 4.34.

Table 4.34: Correlations between aspects of visual perception and the mathematical abilities for each Foundation Phase grade

Grade	Visual Discrimination	Visual Spatial Relationships	Position-in-Space	Visual Closure	Visual Figure-Ground	Visual Analysis & Synthesis
Gr 1	0.52*	0.37**	0.30**	-0.01	0.33**	0.29**
Gr 2	0.13	0.26	0.17	0.05	-0.01	0.28
Gr 3	0.33**	0.12	0.36**	0.34**	0.37**	0.38**

* $p < 0.01$
** $p < 0.05$
For all other correlations $p > 0.05$

From the results in Table 4.34 above, the null hypothesis for Grade 1 can be rejected for all aspects, except for Visual Closure. Visual Discrimination for Grade 1 showed a significant moderate positive correlation ($r=0.52$, $p<0.01$) with the mathematical abilities of learners. As seen in section 4.6.1, the introductory stages of learning to numerate, much like learning to read, necessitates the ability to discern between similarities and differences in the exact formation of numbers.

The further four aspects, namely Visual Spatial Relationships ($r=0.37$, $p<0.05$), Position-in-Space ($r=0.3$, $p<0.05$), Visual Figure-Ground ($r=0.33$, $p<0.05$), and Visual Analysis and Synthesis ($r=0.29$, $p<0.05$), all yielded low correlations with the Grade 1 learners' mathematical achievements, proving that a level of correlation exists for all aspects except Visual Closure. This corresponds with Groffman (2006:270), who reported on Ben-Chaim and Associates' 1989 findings that indicated that mathematics necessitates good spatial sense. Spatial sense referred to aspects such as visual discrimination, visual memory, visual spatial reasoning and perception. The research concluded that the foremost contributor to mathematical proficiency was simultaneous processing.

From the Grade 2 learners' results in Table 4.34 the null hypothesis cannot be rejected as no significant positive correlation exists for any of the aspects.

From the Grade 3 learners' results in Table 4.16 the null hypothesis can be rejected for all visual perceptual aspects, except for Visual Spatial Relationships. The aspects Visual Discrimination ($r=0.33$, $p<0.05$), Position-in-Space ($r=0.36$, $p<0.05$), Visual Closure ($r=0.34$, $p<0.05$), Visual Figure-Ground ($r=0.37$, $p<0.05$) and Visual Analysis and Synthesis ($r=0.38$, $p<0.05$) all yielded low correlations with the mathematical achievements of Grade 3 learners, proving that some level of correlation exists in all except the Visual Spatial Relationships aspect. Scheiman and Gallaway (2006:388) state that the basic foundational visual perceptual aspects enabled the learner to initially recognise letters and numbers (parts) and ultimately words and figures (wholes), facilitating the development of literacy and mathematical concepts.

4.7 CALCULATION OF A VISUAL INTELLIGENCE COEFFICIENT

The amount of variance shared by variables is represented by the coefficient of determination. When the correlation coefficient is squared, the coefficient of determination is obtained (Bester 2003:26). This becomes a measure of variance of the dependent variable, which can be explained by independent variables. The measurement of the amount of variance explained by the different subtests (the independent variables in this research study) could then be utilised in a regression aggression to predict the dependent variable, which is visual age.

The calculation of a visual intelligence coefficient requires a visual age score. In order to predict a visual age score, a Stepwise regression analysis procedure was used. The independent variables used in the Stepwise regression were the various subtests measuring the different aspects of visual perception. The dependent variable was the chronological age of each participant (i.e. Foundation Phase learner).

The subtests were taken up into the regression model. The variables which correlated the best with the chronological age were the Position-in-Space (P-S), Visual Discrimination (VD) and Visual Spatial Relationships (VS-R) subtests, as seen in Table 4.35. The other variables did not meet the 0.5 significance level for entry into the model. These three abovementioned subtests can explain 22% of variance in chronological age.

Table 4.35: Explanation of the variance in chronological age

Variable	**R^2**	**F**	***Df***	**Probability**
Position-in-Space (P-S)	0.19	28.37	(1), 116	$p < 0.0001$
Visual Discrimination (VD)	0.21	15.76	(2), 115	$p < 0.0001$
Visual Spatial Relationships (VS-R)	0.22	10.74	(3), 114	$p < 0.0001$

The equation to predict visual age is the following:

$$\text{Visual Age} = 6{,}358 + 0.054\,(\text{VD}) + 0.032\,(\text{VS-R}) + 0.107\,(\text{P-S}).$$

The final formula for predicting visual intelligence is the following:

$$\text{Visual IQ} = \frac{\text{Visual Age}}{\text{Chr. Age}} \times \frac{100}{1}$$

$$\text{Visual IQ} = \frac{100\,[6.358 + 0.054\,(\text{VD}) + 0.032\,(\text{VS-R}) + 0.107\,(\text{P-S})]}{\text{Chronological Age}}$$

It is important to note that chronological age is explained as a decimal number, e.g. 7 years and 9 months would be represented as 9.75.

4.8 CONCLUSION

An item analysis was done on each developed subtest. For each item, item correlations were calculated. Items that contributed negatively to the total were excluded from the test. Three items from Visual Discrimination (VD) subtest were deleted, 2 items from Visual Spatial Relationships (VS-R), and 1 item from each of the following subtests, Position-in-Space (P-S), Visual Figure-Ground (VF-G), and Visual Analysis and Synthesis (VA/S). The entire subtest Visual Form Constancy proved inconsistent and was therefore excluded. All the items of the subtest Visual Closure contributed positively and were retained in the final subtest.

The reliability of the test was determined by calculating the Cronbach Alpha reliability coefficients of each subtest. The final calculated Cronbach Alpha reliability coefficients range was between the highest (0.84; Position-in-Space (P-S) subtest) and the lowest (0.72; Visual Discrimination (VD) and Visual Analysis and Synthesis (VS/A) subtests). Since the reliability coefficients are higher than 0.7, it can therefore be concluded that the Visual Perceptual Aspects Test (VPAT) is a reliable measuring instrument.

The validity of the VPAT was evaluated by focusing on content and construct validity. To determine construct validity, Pearson Product-Moment correlations were calculated between the scores of each of the six visual perceptual subtests. As expected, the correlations were significantly positive on the 1% level. It can therefore, be concluded that the Visual Perceptual Aspects Test (VPAT) is construct valid.

The correlations between the various subtests and chronological age were used to develop a regression equation in order to predict visual age.

Information from the empirical investigation established that specific visual perceptual aspects relate to the South African Foundation Phase learners' ability to acquire competency in literacy and numeracy skills. The results highlighted the importance for Grade 1 learners to perceive the similarities or differences in letters, numbers or symbols within literacy and numeracy. The development of the visual perceptual aspect of visual discrimination is therefore crucial for Grade 1 learners learning to read, write, spell and numerate (see section 4.6.1-4.6.3). For Grade 2 learners, there is a shift towards developing visual perceptual aspects which relate to visual spatial relationships, especially in acquiring reading; writing and spelling skills (see section 4.6.1 & 4.6.2). In this empirical investigation, however, none of the visual perceptual aspects correlate with numeracy in Grade 2. The visual analytical skills became central for Grade 3 learners. There was a significant correlation between the aspects of visual analysis and synthesis and the Grade 3 learners' achievement in literacy and numeracy (see section 4.6.1 - 4.6.3).

CHAPTER 5

EDUCATIONAL IMPLICATIONS OF THE RESEARCH STUDY AND SUGGESTIONS FOR FURTHER RESEARCH

5.1 INTRODUCTION

The principal objective of this research study was to develop a test which adequately assesses and evaluates the distinct visual perceptual aspects of the South African Foundation Phase learners. Research has shown that visual perceptual aspects are critical for academic learning, performance and competency. The research study focused on two elements, namely a literature study and an empirical investigation. The literature study was undertaken to:

- analyse the construct *visual perception*,
- consider the developmental phase of a Foundation Phase learner within the formal educational context,
- establish the relationship between vision, visual perception and academic learning,
- identify distinct aspects of visual perception which are fundamental to the acquisition of basic literacy and numeracy skills within the Foundation Phase, and
- critically analyse available commercial tests for measuring visual perception.

Literature can be used to shed light on the complex nature of the construct of *visual perception*. There are, however, conflicting studies within literature, which makes analysing and drawing a conclusion difficult (Groffman 2006:255). Owing to the complexity of the visual perception process and its multidisciplinary nature, there appears to be no general agreement with regard to a definition of visual perception (see section 2.3). There is also no consensus among the developers of the various visual perceptual tests purporting to measure the construct of visual perception (see section 2.9.2.2). However, there seems to be relative consensus regarding which aspects of visual perception are fundamental to academic learning, performance and competency (see sections 1.2.1.4 and 2.9.2.2).

When considering the Foundation Phase learner's development, it is important to remember that although there are disagreements among the various theorists and their specific theories or approaches, all theorists support certain tenets:

- the existence of a difference rate of development for each learner,
- the relatively orderly (logical or sequential) progression, and,
- the gradual occurrence of development.

Within the educational psychology context, two areas of development, namely cognitive and psychosocial, play a vital role. Piaget's contribution in cognitive development emphasised the change in the Foundation Phase learner's thought processes and especially how this relates to processing and analysing information. This concrete-operational thought phase facilitates the learner in learning and mastering new skills. The learner also faces the Erikson's psychosocial dilemma of "industry versus inferiority". Learners who are faced with visual perceptual challenges during this phase are at risk of not developing optimally, which tends to impact negatively on the learner's self-esteem, and future cognitive and psychosocial development.

The literature study highlighted that the above-mentioned development tenets also exist in the Foundation Phase learner's visual perceptual development (see sections 1.2.1.2 and 2.7). As learners develop, mature and progress academically, specific aspects of their vision and visual perception mature, refine, consolidate and change by becoming more fluent and automated. A further tenet is that visual perception is also a learnt phenomenon. This applies to the manner in which specific visual perceptual aspects are acquired (i.e. how learners learn or are taught to perceive and process visual information) and its role in how visual information is perceived and processed. Moreover, the adaptableness (flexibility), consolation (comfortability) and effectiveness (competency) of learners when utilising these visual perceptual aspects, also plays an essential role in their academic learning, performance and competency.

The fundamental feature of visual perception in the acquisition of basic literacy and numeracy skills was brought to light in the literature study. Ten distinct aspects of visual perception, which were perceived to relate to the Foundation Phase learners' academic learning potential, were identified (see section 3.4.1.1). In addition, the research study attempted to provide probable answers to understanding the role that these aspects of visual perception play in specific academic phases of formal education.

The majority of the commercially available visual perception tests are pen and pencil assessments, which tend to influence the learner's performance (see section 1.2). These tests are imported from overseas and have not yet been normed for the South African population. The empirical investigation was done to:

a) develop a reliable and valid measuring test which measures distinct aspects of visual perception (see sections 3.4.3; 4.3 and 4.4), and

b) statistically test hypotheses relating to aspects of visual perception as well as selected variables that tend to influence the academic learning, performance and competency of individual South African Foundation Phase learner (see section 4.6).

The results of the empirical investigation provided constructive assistance in understanding how specific visual perceptual aspects relate to the acquisition of particular literacy and numeracy skills (see section 4.6). The test developed for this research study, VPAT, proved reliable (see section 4.3) and construct valid (see section 4.4.2). The conversion of raw scores to stanines made norms available for Grades 1-3 of the South African Foundation Phase (see section 4.5.1). Correlations were used to develop a regression equation for visual intelligence using chronological age and the identified aspects of visual perception (see section 4.7).

Based on the literature study and the conclusions drawn from the empirical investigation, several educational implications and recommendations can be made. The contributions and limitations of this research study as well as further research suggestions will be addressed.

5.2 EDUCATIONAL IMPLICATIONS AND RECOMMENDATIONS

Visual perception is not only a receptive, but also a constructive process which lays the foundation for many other higher level cognitive functions (Deiner 2005:397; Hamill et al 1993:2; Van Romburgh 2006:15). Moreover, effective visual perceptual aspects play a critical role in early academic achievements (Lerner 2000:21; Van Romburgh 2006:11) as well as the later fluency and automaticity in the processing and analysing of visual information (Groffman 2006:255; Schneck 2005:426). The majority of educators, parents and learners, however, are unaware of what role visual perception plays in facilitating the learning process. An appropriate understanding, firstly, tends to facilitate the development of significant ways in which to assess the visual perceptual aspects of learners and, secondly, informs the mentioned stakeholders on effective measures and techniques for essential learning support (Bouwer 2004:84).

The purpose for developing the Visual Perception Aspects Test (VPAT) and statistically testing the formulated hypotheses was twofold in nature. Firstly, to provide assessment practitioners within the South African context with a visual perception test. Secondly, the information gained on the various strengths and challenges of visual perception could be used in collaboration with other information gathered to facilitate appropriate referrals, recommendations and intervention. The focus was on how aspects of visual perception tend to relate to the learner's acquisition of basic literacy (reading, spelling and writing) and numeracy (mathematics) skills. It should be remembered that experiencing success or failure in the above skills, tend to impact on a learner's self-esteem. Therefore, these recommendations and suggestions can assist educational psychologists, educators and parents in making the learning process as effective as possible for identified Foundation Phase learners.

5.2.1 The educational psychologist in practice

Within the field of educational psychology, learning and cognition are prominent areas of study (Human-Vogel 2004:4). The process of learning, however, tends to be affected by various developmental factors (i.e. the learner's physical, language, perceptual, intellectual and emotional development) that are interrelated. This research study focused on distinct aspects of visual perception, regarding various visual perceptual challenges, which relate to cognitive (intellectual), behavioural and emotional (intra- and interpersonal) challenges that a learner may face when performing basic visual literacy and numeracy tasks. The results of this research study provide the educational psychologist with a visual perceptual test which can form part of an assessment battery, a screening test or used as a diagnostic tool. The results of the VPAT can provide basic information about the learner that can be passed on when the learner is referred to other professionals.

The literature study highlights two important aspects of the complexity of vision, visual perception and academic achievement which relates to the role of the educational psychologist. The first is the interdisciplinary nature of working with other professionals. Within an interdisciplinary approach, the educational psychologist will perform basic visual screening assessments and ask a series of questions. Supportive information can be obtained by well structured questionnaires (see Appendix H; Signs and symptoms of visual challenges within the classroom). If any observed visual challenge is indicated, the educational psychologist is able to refer the identified learner. For instance, the learner can be referred for a comprehensive investigation to an optometrist (who practices the profession of evaluating eyes for any defect in vision acuity and/or visual efficiency) or an ophthalmologist (who specialises in the physiological structure of the eye, the treatment of any eye disease and corrective eye surgery). Only after specific visual challenges have been addressed, can the educational psychologist ethically assess the learner's visual perceptual status utilising the VPAT.

Secondly, a standardised test can facilitate a more confident approach to what is being measured, as well as to enhance the communication between other professionals (Scheiman & Gallaway 2006:372). The structured, objective approach of the Visual

Perceptual Aspects Test (VPAT) can be beneficial, especially for less experienced practitioners. The VPAT can be administered as part of a core battery or an auxiliary test to establish additional, collaborative and supportive information for appropriate referral; informed recommendations or developing a sound intervention programme.

An individual assessment using the VPAT can also provide useful qualitative information with regards to the learner's attention and cognitive style (see Appendix F). The VPAT can be used in conjunction with other instruments. For instance, a rapid screening tool, which can be useful for gathering collateral visuospatial information, is the 18-item Shortened Visuospatial Questionnaire (SVS; Cornoldi et al 2003:206; Gentile 2005:169). Should the learner display any visual perceptual challenges with regard to visual spatial orientation and/or visual-motor integration, the educational psychologist is able to refer the learner to an occupational therapist (who specialises in the evaluation and management of challenges within a learner's fine-motor and/or perceptual systems) for a comprehensive investigation.

Owing to the critical role that visual perception plays in acquiring reading, spelling, writing and numerical skills, it is expected that the learner would lag behind in the acquisition of these fundamental skills. The learner can be referred to a remedial therapist (who designs and implements specialised educational programmes) with useful quantitative and qualitative information to assist the therapist. In this way, the educational psychologist forms part of an interdisciplinary collaboration which facilitates the pursuit and development of sound interventions that support and compliment one another (Engelbrecht 2004:250).

The second aspect relates to the importance of the developmental nature of visual perceptual aspects within the Foundation Phase learner. Knowledge about the developmental nature of vision, visual perception and the educational implications for the Foundation Phase learner is essential. The developmental nature and educational implications were described in Chapter 2. From a developmental perspective, one of the most important results of the empirical investigation relates to the critical foundational nature of visual discrimination and its role in learning to read, spell, write and numerate, especially for Grade 1 learners. The empirical investigation also indicates the various shifts towards developing more refined and enhanced aspects in visual spatial orientation in Grade 2 and the emphasis on visual analytical aspects in Grade 3.

5.2.2 The educator in the classroom

Educators play a vital role in observing how the learner approaches and accomplishes visual tasks and activities within a classroom setting. Owing to the crucial role visual perception plays within the Foundation Phase, the VPAT provides Foundation Phase educators with a simple screening tool to identify learners with visual perceptual challenges. The test can be administered in an individual or group assessment situation. Information gained from the VPAT can assist the educator to better understand the challenges that the learner experiences in accomplishing reading, spelling, writing and numerical activities and tasks. This understanding facilitates the educator's ability to assist learners in reaching their optimal academic potential.

From this research study, the following recommendations can be made for facilitating the learning process. When learning to read or write (i.e. a letter or a number), the educator should engage as many modalities as possible. For example allowing the learner to:

- scan the classroom to locate a simple letter or number on any printed material in the classroom (visual scanning encourages accommodative eye movements)
- use clay or plasticine to shape the letter or number (a tactile experience provides meaning to vision)
- use the body to shape the letter or number (a kinaesthetic experience facilitates the importance of body awareness in visual perception)
- describe to a friend how a letter or number is constructed (auditory input can enhances visual memory).

This type of practical application emphasises the way in which specific visual perceptual aspects can be acquired, refined and enhanced within a classroom environment.

5.2.3 The parent in the home

This research study provides educational psychologists and educators with valuable information to "demystify" visual perceptual challenges within the educational context, to the parents and the learner. The information gained from the VPAT together with collateral information, can be used to explain the specific nature of the visual perception challenge. This demystification will not only help to soothe and empower the learner, but also aid the parents who play a key role in the learner's learning support (see section 1.2.1.3). The value of this research study for the parents, therefore, lies in the provisioning of additional structured recommendations and practical suggestions which can best service their child.

Parents are encouraged to find various opportunities within the home or social environment to engage their child in learning by applying and practising specific visual perceptual aspects. There are a number of practical visual discriminatory exercises (i.e. sorting laundry, crockery and cutlery) to be found within the home situation. For example engage the child in sorting cutlery (grouping knives, forks and spoons) allows for the initial foundation of *recognising* (what are the key features) and *matching* (are they exactly the same) to be achieved. A further visual discriminatory aspect that can be practically experienced and taught is visual form constancy. For example, spoons can be sorted into various categories: teaspoons, tablespoons or soup spoons; there are also metal spoons and plastic spoons (*categorisation*).

In conclusion, the VPAT can be utilised by the educational psychologist, educators and parents to assist the learner who experiences visual perceptual challenges within the educational context.

A discussion of the contribution and limitations of the research study follows. The chapter concludes with suggestions for further research and the final remarks.

5.3 CONTRIBUTIONS OF THE RESEARCH STUDY

This research study contributes, firstly, to providing an understanding of the phenomenon of visual perception and the importance of effective visual perceptual aspects, especially during the initial stages of basic literacy and numeracy acquisition for the Foundation Phase learner in South Africa. Ten aspects of visual perception were identified in the literature study, namely visual discrimination, visual memory, visual spatial relationships, visual form constancy, visual sequential memory, position-in-space, visual closure, visual figure-ground and visual analysis and synthesis. These aspects of visual perception, which have a tendency to influence the basic academic competency, were identified, defined and thereafter empirically tested.

Secondly, this research study contributes to the development of a reliable and construct valid Visual Perceptual Aspects Test (VPAT). The test was developed for use in the assessment of the above-mentioned distinct visual perceptual aspects.

Thirdly, this research study contributes by the use of the VPAT (together with other collateral information gathered) to facilitate referrals and interventions of Foundation Phase learners, who are experiencing visual perception challenges within the educational context.

Fourthly, this research study contributes by the value of the Visual Perceptual Aspects Test (VPAT) as a proactive method in the early screening of Foundation Phase learners.

5.4 LIMITATIONS OF THE RESEARCH STUDY AND SUGGESTIONS FOR FURTHER RESEARCH

In addressing the research problem, this research study's principal aim was to develop a test which would be standardised for South African learners in the Foundation Phase. Although this research study, as a limited-scope dissertation, achieved a great deal, there still remain areas which require further attention.

The first area of limitation was the actual sample size. This small-scale study, which is limited to a specific geographical setting, cannot be considered to be representative of the total diverse population of South African Foundation Phase learners. Caution must be applied when drawing generalised conclusions (Mulder 1996:59). The findings of this research study can, however, be used to provide direction for future research on this topic. Although the sample study was adequate, conducting this research in all the provinces would enhance the test's reliability and validity. As the Visual Perceptual Aspects Test (VPAT) was standardised, it would be beneficial to:

- translate the test instructions for each subtest into Afrikaans, Xhosa and Zulu,
- include learners from rural and private schools,
- assess and include Grade R learners in the next testing phase.

In particular, these intentions would augment the standardisation for the Visual Perceptual Aspects Test (VPAT). The test would be more representative of the identified population and provide norms for the entire South African Foundation Phase population.

A second limitation is that the visual memory and visual sequential memory subtests were excluded. Visual memory is a crucial aspect of visual perception; therefore, these subtests are essential parts of a visual perception test. Careful attention needs to be given to finding an appropriate way of testing these aspects of visual memory within a group situation.

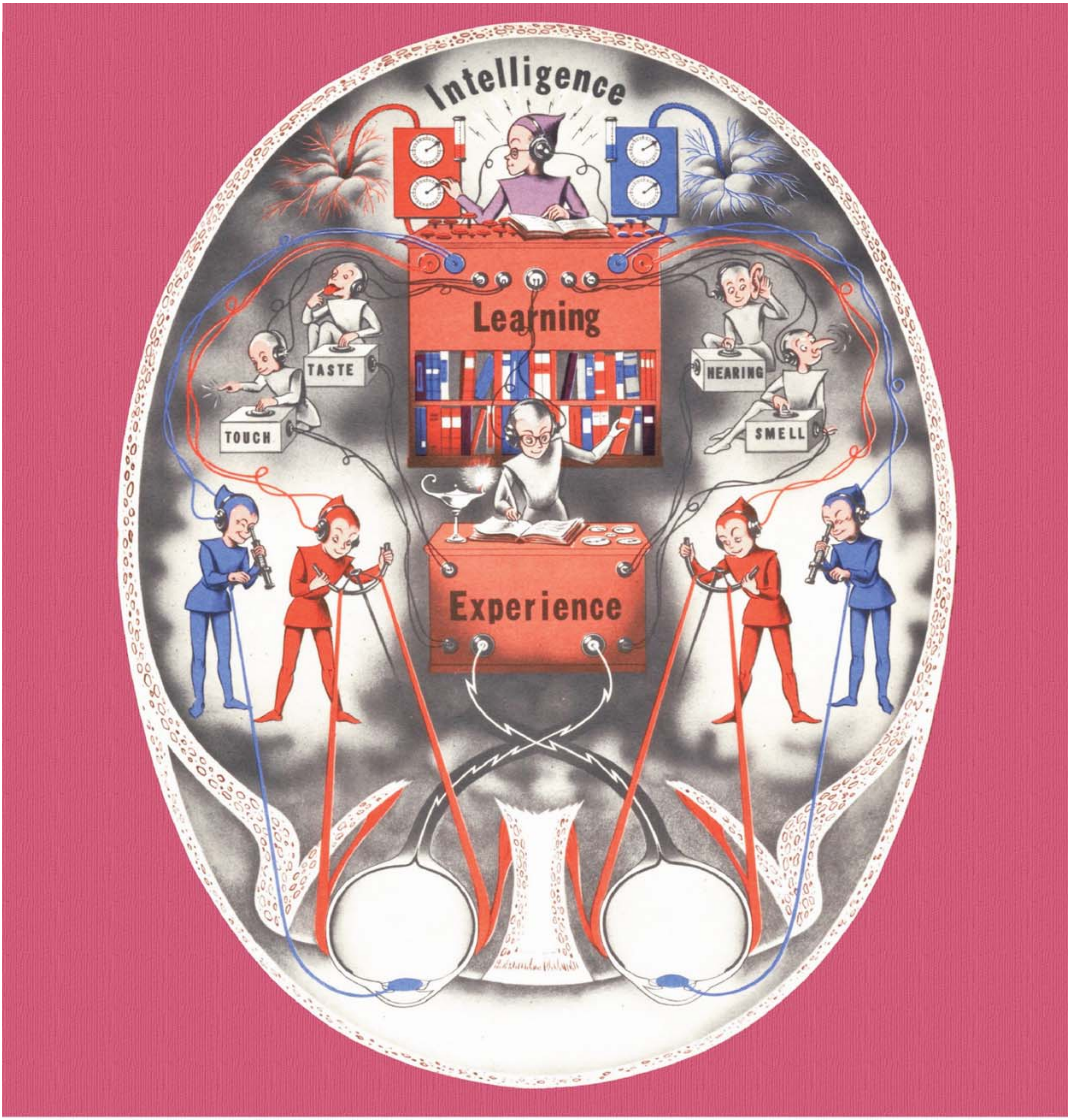
A third limitation is that specific items from the original Visual Perceptual Aspects Test (VPAT) were discarded during the item analysis (see section 4.2). Various items were omitted and the development of new items to replace these would significantly enhance the test's reliability.

A fourth limitation is that the Visual Form Constancy subtest was omitted after an item analysis was done. As an indicator of mature perception, it is an important subtest which should ideally not be discarded. A challenging area remains to investigate the possible reasons for this.

5.5 FINAL REMARKS

It was never the intention of the researcher to reinvent the wheel, but to rather attempt to adapt it for the South African terrain. Even though there were limitations, this research study nonetheless generated useful information and a practical application (the VPAT) that can contribute to a clearer understanding of the construct visual perception and the Foundation Phase learner within the South African academic context.

"Research is never conclusive, …
... genuine research creates more problems than it resolves ...
… but we learn by doing" (Leedy 1989:9-12).



A DIAGRAMMATIC INTERPRETATION OF VISION - or - how we see

THE EYES, as light receptors, feed information into the brain. Note: The two eyes are separated by bone – the only connection is in the brain.

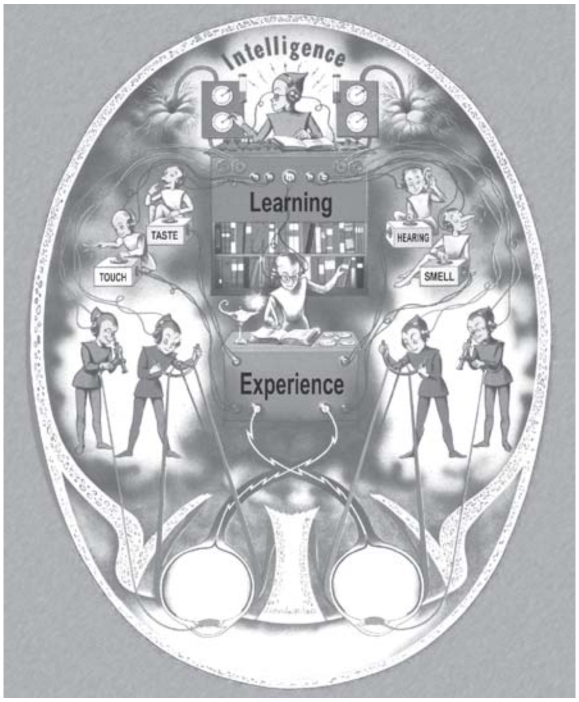
RED represents the control of the voluntary nervous system which turns and points the eyes.

BLUE indicates the involuntary nervouse system which fosuses for various distances.

These two nervous systems must coordinate for accurate, comfortable, efficient seeing.

– **THE OTHER SENSES** also feed information into the brain.

INTELLIGENCE = the use of **Experience + Learning**



DIAGRAMMATIC INTERPRETATION OF VISION

the story of vision...

When you say "I see"- the meaning involves more than looking; you also mean "I understand". . . A "man of great vision" is one of good judgment and superior intelligence . . . "Perception" is not only the ability to see; it is also the ability to understand.

All through the ages, these words have interwoven and overlapped in their meaning-vision, intelligence, sight, understanding, judgment, comprehension.

This is not just an accident of language. It is because seeing and intelligence are so closely related in the human brain. Most of what we learn comes to us through vision which starts in the eyes, but only through proper direction by the brain do we see.

Two Eyes . . . four controls . . . one brain

Vision is a two-way street-an avenue for recording in the brain the ingredients of knowledge and intelligence - and back again as the control by the brain to make the seeing possible. The fanciful drawing of a "cross-section" of the head at the left illustrates these two processes.

Separate control mechanisms . . .

All seeing starts, of course, in the eyes, as images formed by light reflected from things at which you look. But, even before this first step, the eyes must be pointed in the right direction, and be focused for the right distance. These two adjustments are made by different sets of muscles-are even controlled by different nervous systems.

The pointing, or steering, mechanism is a voluntary action controlled by brain impulses. It is illustrated here by the darker figures which direct the six muscles operating each of the eyes. Focusing is involuntary, done unconsciously. It is indicated by the checkered figures which direct the muscle surrounding the lens of each eye.

The function of vision requires that involuntary and voluntary nervous systems work together simultaneously. They must be exactly balanced, and make split-second adjustments hundreds of times a minute-hour-after-hour, day-after-day. Note, too, that there is no muscular connection between the two eyes. Each is in its own orbit, outside the skull, separated from the other by bone. The two eyes must work together by a balance created in the brain and controlled through the nervous systems.

The eye is a window for the brain...

When the proper response to the brain's messages to the eyes has made it possible for the eyes to form images on their rear surfaces, the light releases surges of nerve energy. These enter the brain through the crossed optic nerves. Each message first comes to the department labeled "experience," to be sorted, classified and identified as new information. Only as you "have seen that, or something like it, before," does it have meaning for you.

Note that experience is hooked up also to the other senses. The feel, the taste, the sound, the smell and the appearance of things have been added to your experience and stored in memory since the first day of your life. How well and how quickly you are able to interpret each new bit of information depends on the breadth of your experience and the efficiency of your memory.

Learning (the factory and storehouse of knowledge) is built on experience, memory and reliability of incoming information. Your judgment and intelligence depend on your learning-just as your learning depends on your experience and memory.

Failure in any single step of the precise and positive coordination required by the visual process can have serious effects. "Errors of judgment," "accidents," "mistakes," "backwardness in children, may he failures of intelligence resulting from unreliable incoming information, or faulty experience.

A complex physical and mental process requires a highly specialized professional service...

Optometry is the profession of vision care. It is concerned with seeing as applied to clarity of eyesight, clarity of thinking and clarity of learning. Optometry achieves its purpose sometimes through the skilled prescription of glasses alone; sometimes through visual training procedures; and sometimes by both.

Lenses affect the focus of the eyes. But, optometry also recognizes that this is a direct adjustment of only one step in the intricate cycle and delicate balance of vision. This adjustment may affect, indirectly, many other bodily functions as well.

Optometric research has resulted in visual training procedures which, through the eyes, can rearrange balancing and matching processes in the brain-to make information reliable, experience accurate, learning easier and intelligence greater.

Optometrists provide a professional service founded on the belief that vision, next to life itself, is man's most precious gift; a service dedicated to the scientific analysis and correction of vision as a process of learning and intelligence.

The *Diagrammatic Interpretation of Vision* was designed and developed in 1958 as a public service by the Optometric Extension Program Foundation, Inc. (Nonprofit)-dedicated to education and research in vision-Santa Ana, California

Printed in U.S.A

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APPENDIX A

THE VISUAL SYSTEM AND VISUAL INFORMATION PROCESSING

A1.1 The eye's anatomy and physiology, and visual stimuli

Eyes are the receptors of sight. A bony socket houses each eye (Cheatum & Hammond 2000:264). The eyes are held in position by tendons of the eye muscles, which traverse a 'pulley' in the skull (Gregory 1998:44). There are six eye muscles situated on the outside of each eye, which are connected to the sclera's sides, top and bottom (Cheatum & Hammond 2000:264; Gregory 1998:44; Landsberg 2005:331). The eye muscles facilitate the coordination of the movements of the eye (i.e. looking up, down or sideways and focusing together; refer to Appendix C). When stimulated by light waves, the eyes transmit impulses by means of neurons to the brain to provide the sensation of sight.

The human lens focuses the light in an inverted form onto the retina, which is the inner-most layer of three outer layers of the eye. The retina's function is to act as a filter (Bruce et al 1996:37) for the light patterns that are converted to neural messages (Rookes & Willson 2000:6). It consists of a layer of photoreceptors (light receptors) as well as interconnected nerve cells (Gregory 1998:52). The retina consists of ten layers of nerve cells that are divided into three main layers:

- the layers of ganglion cells
- a layer of bipolar cells which join the ganglion cells to the receptors, and
- the photoreceptor layer consisting of two kinds of light receptor cells – rods and cones (Twining 1998:248-249).

The function of the cones in the retina is to enable the eye to see in the daylight, to distinguish colour and objects which are stationary, and to see the fine details. The function of the rods in the retina is to assist the eye in low light conditions, to distinguish objects which move, and only distinguishes black and white tones. The rods also facilitate peripheral vision.

At the centre of the retina is a very dense area of cones (Twining 1998:249). This dense, yellow spot of cones is called the *fovea*. It is a shallow depression in the retina which facilitates the sharpest vision, namely the ability to recognise faces, to scrutinise pictures and to read print. A large number of rods are packed just outside the fovea.

A1.2 The visual pathways and neural messages

When entering the eye, light passes through the initial two layers of the retina and arrives at the cones and rods (the photoreceptor layer) which contain pigments to absorb light and convert it to electrical impulses (Landsberg 2005:331). Electrical signals are generated due to chemical changes which transpire within the rods and cones (light is converted into neural information) and these signals are then transmitted by means of the bipolar cells to activate the ganglion cells.

These coded, electrical neural messages proceed along the axons of the ganglion cells, which eventually join together to form the optic nerve. This bundle of long fibres of nerve cells pushes through the back of the retina and transmits the information to the visual cortex of the cerebrum (the occipital lobe) of the brain (Twining 1998:248; Rookes & Willson 2000:8). Where the optic nerves unite and leave the eye (*optic disc*), there is a small area without any receptors known as the "blind spot". Owing to a lack of rods and cones, the blind spot is unable to receive any image (Gregory 1998:58).

The visual information, now a neural message, is assembled by the bundle of axons, the *optic nerve*. Both eyes' optic nerves come together at a point in the brain which resembles an **X** in appearance. At this point, the nerve fibres of each eye divide and is known as the *optic chiasma*. The first half of the optic chiasma is the nasal retina (the half of the retina closest to the nose) and the second half is the temporal retina (the half of the retina closest to the side of the head). What now transpires is that fibres from nasal retina cross to the opposite side of the brain, but the temporal retina's nerve fibres continue in the same hemisphere, implying that visual information is carried *ipsilaterally* (Schneck 2005:413).

Hubel and Wiesel (1979, in Twining 1998:250) demonstrated that the neural information proceeds to the brain in millions of "bits" of chemical information. These "bits" are reassembled in the brain into the initial image. Although, now it is correctly transposed. Continuing on either side of the brain, the optic nerves, now referred to as the *optic tract,* proceed through the relay station, the lateral geniculate nucleus (LGN) of each hemisphere (Gregory 1998:75) into the optic thalamus (Schneck 2005:413) and ultimately converge on an area of the brain, the *visual cortex* or *striate cortex* (Rookes & Willson 2000:9-10) – area 17 of the occipital lobe (Schneck 2005:413).

A1.3 Visual centres of the brain and visual information processing

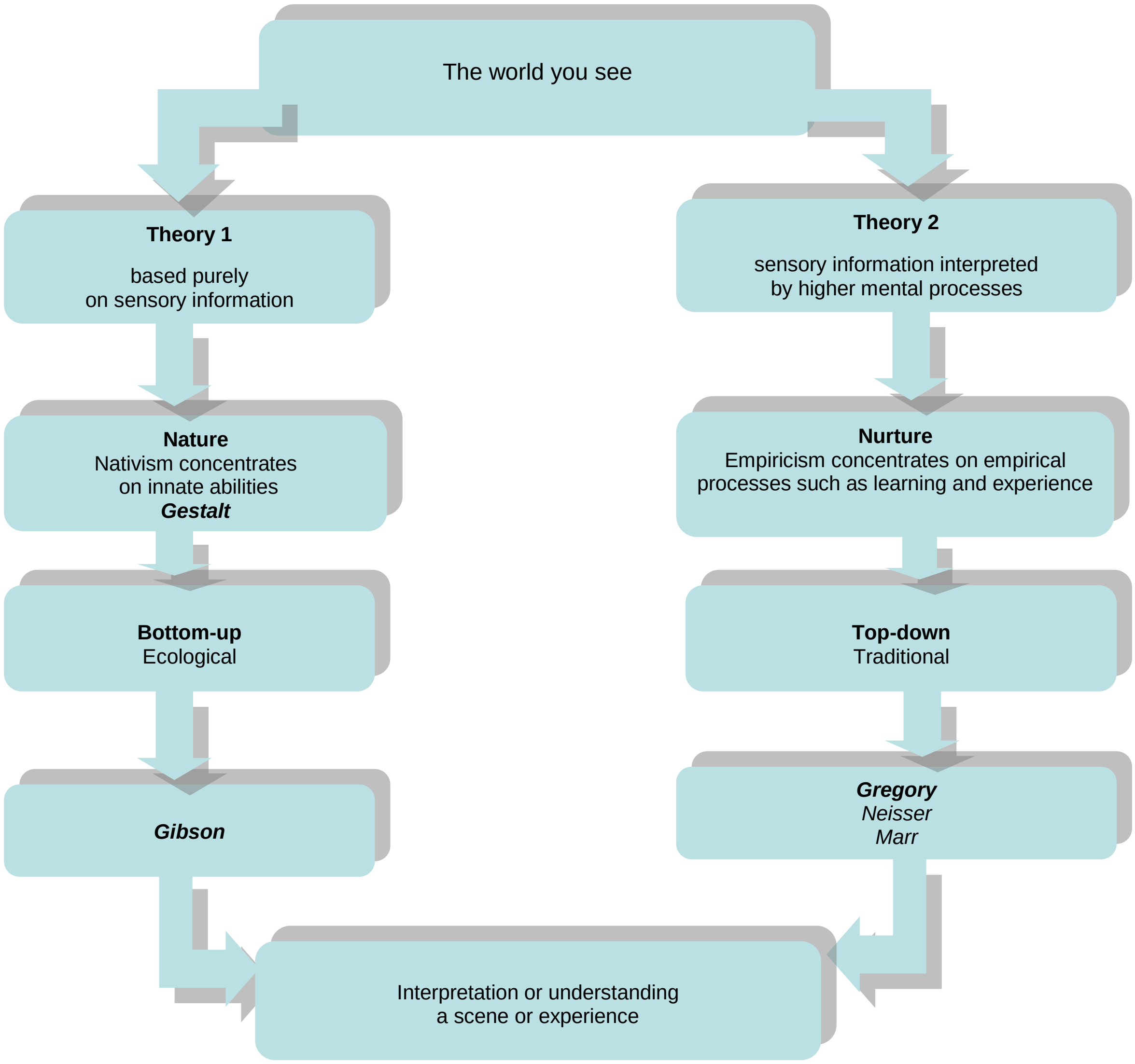
Refined visual information is sent by means of areas 18 and 19 from the occipital cortex in two directions (Schneck 2005:413–414). Some impulses flow upwards along a pathway known as *the dorsal stream* to the posterior parietal lobe for processing. Dominant in the dorsal stream is the magnocelluar channel, which is associated with depth perception, motion, stereoscopic vision and spatial organisation interpretation (Hendry & Calkins, in Schneck 2005:414; Turnbull 2004:147). There, visuospatial processing transpires and the focus is on "where" with regard to the location of the object in relation to the individual, as well as the individual's relationship to objects in space.

Other impulses flow downwards in *the ventral stream* to the inferior temporal lobe, where processing of visual objects occurs. There, visual information is analysed for particular details of form, colour and size. The focus is on recognition of pattern, detail and remembering the qualities of the objects. In the ventral stream, the paravocellular channel is dominant. Kandel, Schwartz and Jesell (1990, in Schneck 2005:414) contend that this channel is significant for colour perception, and detailed analysis of shape as well as the surface properties of objects.

For the brain to interpret visual perceptual information accurately, the visual system and components explained in the above sections, must work efficiently. If there are any problems with the structure of the eye or the way that information is relayed to the brain, the learner will experience visual perceptual challenges.

APPENDIX B

A DIAGRAMMATIC REPRESENTATION OF BOTTOM-UP AND TOP-DOWN (TRADITIONAL) THEORIES



A diagrammatic representation of Bottom-up and Top-down (Traditional) Theories.
(Source: Adapted from Twining, 1998:130).

APPENDIX C

APPENDIX C

VISUAL-RECEPTIVE PROCESSES

C1.1 Visual Receptive Processes

The oculomotor system makes the various visual-receptive processes possible. The reception of visual stimuli includes the following components: visual acuity; saccadic eye movements; fixation; pursuit; accommodation; binocular fusion and stereopsis; as well as convergence and divergence (Cheatum & Hammond 2000:267; Schneck 2005:414).

C1.1.1 Visual acuity: Sight

Visual acuity refers to the eye's ability to distinguish detail (Snyman & Bloem, in Engelbrecht & Green 2001:172). Acuity relates to explicitly how acute or sharp the visual image strikes the retina (Cheatum & Hammond 2000:266). Carey's analogy (telephonic interview October 2006), *"if an individual owned a pair of running shoes it did not automatically make him a runner",* probably best describes and supports the statement that although an individual has the precision (the accuracy), the ability to see the shape, colour, texture and/or position of an object; it does not always equate to being able to understand what is seen (Gardiner 1988:6).

According to Warren (1997:44), the function of visual acuity is to ensure that the accuracy of the visual information is conveyed to the individual's CNS. He argues that the engaging of higher visual functions is prevented if the visual image is inadequate (either misrepresented or insufficient). For instance, a learner may read ***bad*** instead of ***bed***. This due to the fact that the learner can see the global pattern formulation, but cannot clearly see the details (the letter features).

The ability to discern a well illustrated black and white stimulus (visual acuity) is generally clinically assessed by a trained optometrist. The most commonly used basic screening test is the standard Snellen Wall Chart (Cheatum & Hammond 2000:273). During screening, an individual is requested to read standard-sized letters, from a chart, whilst standing at a standard distance (approximately 6.1m). If this is accurately read, the individual has 6/6 (the statistical norm) or formerly known as 20/20 eyesight (Deiner 1999:358). The disadvantages mentioned below play a crucial role when considering developing a test for visual perception for South African Foundation Phase learners, as similar factors have a tendency to play a role when assessing the visual perceptual aspects of young learners.

The usage of the Snellen Wall Chart has disadvantages which are depended on various variables, for example, the individual's possible lack of alphabetic knowledge (visual memory); or how some letters (visual discrimination, form constancy and spatial relations) are so similar that an anxious or unsure learner might venture guessing; or that an individual may tend to memorises (i.e. rote learn) the order of the letters (visual sequential memory) to accomplish the task. This rote learning occurs if individuals are tested whilst in the presence of other individuals (pre-exposure).

Snellen E Test affords the learner who lacks alphabetical knowledge, the opportunity to indicate the direction, by either pointing or hold up a large letter E to match the target stimulus on the chart (Deiner 1999:358). This is also not an infallible method for young learners. Deiner cautions that there exist the possibilities that the young learner may be anxious or experience directionality difficulties, namely, a visual-spatial perceptual function. Salvia and Ysseldyke (1995, in Deiner 1999:362) also advise that basic visual screening frequently fails to identify the learner with myopia (near-vision problems and/or a refractive error) which is critical for reading and writing activities. For the most part demands placed on the learner's visual system are desk activities involving near-point vision relating to the reading and writing distance (Cheatum & Hammond 273). Other problems may relate to the possible failure to identify physical problems with the eye; and/or to identify visual perceptual challenges.

In summary, visual acuity addresses the question of how well the learner can see the visual stimuli; to thereafter be capable to process and ultimately understand what is seen.

C1.1.2 Visual-receptive functions: Efficiency visual skills

Borsting (2006:36) refers to *vision efficiency* as accommodation, vergence and oculomotor aspects. According to Cheatum and Hammond (2000: 267), visual perception is depend on the visual skills of accommodation (convergent and divergent), binocular fusion (blending of images), fixation (focussing on), visual pursuit or tracking (ocular motor tracking), depth perception, visual memory (recall) and visual sequential memory (recalling the order).

C1.1.2.1 Eye movements

In academic learning, an important part of reading is the congruent movements of the eyes across the page or line of print to be able to encode (to determine) the print (Lane 2005:12). As the eyes move across a page of text, there are three types of eye movements essential for efficient visual processing: saccades, fixation and pursuit (Borsting 2006:38). These three above-mentioned ocular motors areas are the main concern when attending to children (Lane 2005:18).

- *Saccades eye movements* refer to a series of rapid forward rightward eye movements; or in the opposite direction (leftward) when moving from the end of the line to the next line; or *regressive eye movements,* which occur about 15% of time and normally only a few characters as a result of text confusion or when experiencing a problem with comprehending (Lane 2005:12). Several saccadic fixations are involved in reading a line in a book or from printed matter (Cheatum & Hammond 2000:281). Beginner readers, as well as poor readers have excessive regressions.

- *Fixations* are the pausing of the eyes to take in the visual information. The fixations refer to the stopping to look, which is combined with the ability to remain focus on the object for a length of time (Cheatum & Hammond 2000:267). Normal readers on average pause and hold visual information on fovea for 250msec (Lane 2005:13 & 18). The *span of recognition* (or perceptual span) refers to the amount of visual information available to the brain at the time of fixation. The norm, for the Foundation Phase learner, is to sustain steady fixation on a target for a minimum of 10 seconds.

- *Pursuit or tracking* is the ability to control the fine eye movements required whilst following a moving object or moving the eyes across a printed page. This ocular motor ability refers to the accurately pointing of the eyes onto an object whether moving or stationary and to keep the eyes on it (Barry et al 2006:3). Tracking is especially important for reading, as it requires the eye to follow (pursue) a line of print. The learner's eyes track (move) across the page whilst maintaining visual attention on the printed text and at the same time as gaining and losing fixation.

Borsting (2006:39) states there is evidence to support the development of pursuit eye movement during childhood. According to Schneck (2005:419), the developmental pattern for the controlling of tracking aspects progress from horizontal eye movements to vertical, diagonal and circular movement directions of the eye. The skills of eye-tracking, however, are not fully developed before the learner reaches the age of seven. If both the head and eyes move as a unit whilst tracking an object 20 to 30cm from the face, the skill is still developing (Schneck 2005:419), especially if the individual is younger than five (Cheatum & Hammond 2000:278). Paying attention to and visually tracking an object is possible for a five year old, however, the eye movements are neither smooth nor sustain for any length of time. There is a tendency to move their head and/or to overshoot the target.

C1.1.2.2 Other oculomotor skills

- *Binocular coordination* (also referred to as *binocular fusion*) is the ability to coordinate the two eyes together, and is one of the most important visual skills. Binocular fusion is the mental ability of combining two images with two prerequisites (motor and sensory) to form a single percept (Schneck 2005:415). For the brain to fuse each image from either eye, the eyes must be able to accurately coordinate and align (Barry et al 2006:3). The aligning is the first prerequisite; and known as *motor fusion*. Whilst six extraocular muscles of each eye must coordinate together with precision. *Sensory fusion* is the compatibility of the size and clarity of the two eyes (Schneck 2005:415) and the second prerequisite. Although the majority of individuals are born with two eyes, each individual must learn to work and team the two eyes together. There are individuals who naturally control their eyes movements, yet others just cannot.

- *Accommodation* refers to the process used to focus on objects at various distances. This ability is depended on eye's muscles and the autonomic nervous system (Cheatum & Hammond 2000:286). For the learner to obtain clear vision, the internal ocular muscle (the ciliary's muscle) contract causing a change in the eye's crystalline lens (Schneck 2006:415). The visual system is therefore capable of adjusting to change in distance. The learner's visual system can therefore facilitate making the transition from focusing on the text in book or piece of paper (near point) to the white or chalk board (far point).

Vergence allows eyes to be move in the opposite directions enabling simultaneous single object images on the foveas to fuse both images into one (Lane 2005:18). The maintenance of this ocular alignment is the responsibility of the vergence system which consists of sensory and motor components (Borsting 2006:37).

- *Convergence* (convergent accommodation) relates to an individual's ability to maintain single vision at a near distance. This requires the act of fixating both eyes on a target, for a sustain amount of time, as it is present or moved to within a distance of 6-8 cm (the norm) from the individual's nose. An amount of increased stress is, therefore placed on the visual system, as the eyes move towards the nose. Reading and writing demands that the eyes turn inward toward the medial (middle) plane (Cheatum & Hammond 2000:267; Schneck 2005:415). Double vision can result from insufficient convergence. (Cheatum & Hammond 2000:287).

- *Divergence* (divergent accommodation) relates to an individual's ability to maintain single vision (focus) on an object at either a distance or as it moves away from the face. Learners are constantly faced with this type of task whilst reading or writing. The eyes will diverge if their focus needs to shift to the teacher who is speaking or writing on the board.

Schneck (2006:419) states that at the age of five, upper limit of accommodation is reached. Borsting (2006:37), however, states that developmental factors in the school-age individual influence the accommodative responses (e.g. amplitude, lag and facility) based on research undertaken by Rouse and his colleagues.

In summary, visual efficiency relates to adequate and appropriate oculomotor control. Questions addressed pertain to: *are the eyes aligned properly, are eye movements coordinated and accurate; are eye-focusing skills appropriate and efficient to facilitate the accurate processing of visual information to facilitate visual perception*?

C1.1.3 Effects of deficit visual-receptive functions

Effective visual acuity and efficient visual skills are required for efficient visual information processing. Yet, if any of these above visual abilities are not functioning properly or possibly lacking, it has a tendency to affect the learner's visual perceptual capabilities, as well as to compel the learner to subconsciously work harder and exert more energy. According to Erhardt and Duckman (1997:136), learners tend to develop strategies and compensation that may seem effective in specific situations, but not always. They inform that there is a tendency to exert so much effort into controlling the various oculomotor processes for reading and writing that insufficient energy levels remain for cognitive processing. It frequently manifests in physical symptoms which presents as headaches, fatigue and other eyestrain related problems (i.e. dizziness and squinting; Cheatum & Hammond 2000:273). Visual distress and fatigue result in a display of certain behavioural indicators and tends to manifest or be described as avoidance (non-compliant), aggressive outbursts, covering or closing one eye, daydreaming, and/or frustration. These visible outward signs and symptoms are frequently the first indication a parent/caregiver or teacher will notice.

Visual-related problems involve both physiological and psychological elements (Taylor 2001:387). If the problems relating to vision are misunderstood or "go unnoticed," Fick (personal interview, July 2006) informs that there is a tendency for female learners to work harder placing undue strain on the visual system, which frequently results in myopia (short-sightedness). Male learners, on the other hand, were more inclined to shy away from the visual distress and become increasingly task avoidant. Motivation is therefore affected, which has a tendency to influence the individual's sense of self-confidence and self-worth (Irlen 2005:2).

In summary, different sensorimotor components, in both optical and the neural systems, are necessary for functional vision and visual processing of information. Only once these above mentioned physical visual information acquisition components are in place can it be feasible for the individual Foundation Phase learner to undertake an assessment of the various aspects of visual perception.

APPENDIX D

APPENDIX D

LETTER REQUESTING PERMISSION

Dear Parent/Caregiver

I am currently a student with the University of South Africa and wish to undertake research for my Master's Degree in the field of educational psychology. The proposed research is aimed at developing a test to assess the visual perceptual aspects of Foundation Phase learners.

Effective visual skills are a part of the essential building blocks required by children to perform optimally at school. It is estimated that approximately 80% of what children learn is assimilated through the regular use of their eyes whether at play; or within the classroom. Yet there is a significant difference as well as importance implied by what is meant by the "sight" and "vision" of any individual. "**Sight**" is exclusively the individual's ability **to see**, whereas "**vision**" is the brain's ability to identify, interpret and understand the information, which comes to it through the eyes, as this **provides the meaning to what is seen**.

At birth, virtually all children are gifted with eyesight. Yet vision begins to develop at birth. Vision and visual perception requires learning as well as development. In formal learning activities such as writing, reading, spelling and mathematics, vision and visual perception play a crucial role in a child achieving academic competence.

The focus of the research is to gain a better understanding of a learner's visual perception abilities. The ultimate aim is to be able to effectively use this gathered information for the development of an effective assessment tool, which may benefit your child, as well as other children within the South African context. This is therefore a friendly request to you, as the parent or caregiver, to allow your child to participate in this research project. **Consent to conduct research was granted with the blessing of both XXXXXXXXXX Primary as well as the Western Cape Education Department**. The assurance is given that complete confidentiality will be mandated in reporting the research results.

By your granting permission, your child will be asked to complete child-friendly activities. The assessment will be done during school hours on the school premises, and will not exceed the duration of one hour. The Grade 1 and 2 learners will partake in these activities on Thursday morning, while learners from Grade 3 will complete the activities on Friday morning. It would be preferable if you refrain from discussing anything regarding the research with your child prior to this research date. Should you be interested, arrangements can be made to discuss the findings during a general feedback session.

Yours sincerely

Sylvia Clutten

Supervision: Prof G Bester
Department of Education Studies
University of South Africa
UNISA

PARENTS/CAREGIVERS: PERMISSION

Title of research project:

The development of a visual perceptual test for learners in the foundation phase

DECLARATION OF PARENTS/CAREGIVERS:

I, ____ the undersigned, in my

capacity as parent/caregiver (delete which is not applicable) of __________________ (child)

____ (address)

hereby give consent to my child's participation in the above-mentioned project.

Signed at _____________________ on ____2007.

Signed (Parent/Caregiver) ____

APPENDIX E

VISUAL PERCEPTUAL ASPECTS TEST (VPAT) SCORE SHEET

				Coding numbers	Column
Name:	______________________________		(001-150)	☐☐☐	c 1-3
Gender:	male	=	1		c 4
	female	=	2	☐	
Date of Assessment:	________ /________ / ________	=	yymmdd		
Date of Birth:	________ /________ / ________	=	yymmdd		
Chronological Age:	________:________	=	yy:mm	☐☐☐☐☐	c 5-9
Language:	English	=	1		
	Afrikaans	=	2		
	isiXhosa	=	3		
	isiZulu	=	4		
	Other	=	5	☐	c 10
Relevant Background Information:	no prescription lenses	=	0		
	wears prescription lenses	=	1		
	diagnosed with Attention Deficit Disorder	=	2		
	a learner with ADHD who is medicated	=	3	☐	c 11
School:	Private	=	1		
	Government - urban	=	2		
	Government - rural	=	3	☐	c 12
Grade:	1	=	1		
	2	=	2		
	3	=	3	☐	c 13

Visual Discriminatory Aspects

VD (c 14-29) + VFC (c 30-45) = c 14-45

Visual Discrimination (VD)		A	B	C	D	E	F	G	c 14-29	
Item 1	response = 0 or 1	1	0							c 14
2		1	0							c 15
3		0	1							c 16
4		0	1							c 17
5		0	0	1						c 18
6		0	0	1						c 19
7		0	1	0						c 20
8		0	0	1						c 21
9		0	0	1	0	0				c 22
10		0	0	0	0	1				c 23
11		0	0	0	1	0				c 24
12		0	1	0	0	0				c 25
13		0	0	0	0	1	0	0		c 26
14		0	0	0	0	0	0	1		c 27
15		0	0	1	0	0	0	0		c 28
16		0	0	0	1	0	0	0		c 29

Visual Form Constancy (VFC)		A	B	C	D	E	F	G	c 30-45	
Item 1	response = 0 or 1	1	0							c 30
2		0	1							c 31
3		0	1							c 32
4		0	1							c 33
5		0	0	1						c 34
6		0	1	0						c 35
7		0	1	0						c 36
8		0	0	1						c 37
9		0	0	1	0	0				c 38
10		1	0	0	0	0				c 39
11		0	0	0	1	0				c 40
12		0	1	0	0	0				c 41
13		1	0	0	0	0	0	0		c 42
14		0	0	0	1	0	0	0		c 43
15		0	0	0	0	1	0	0		c 44
16		0	1	0	0	0	0	0		c 45

Visual Memory Aspects

VM (c 46-61) + VSM (c 62-77) = c 46 - 77

Visual Memory (VM)		A	B	C	D	E	F	G	c 46-61	
Item 1	response = 0 or 1	1	0							c 46
2		0	1							c 47
3		0	0	1						c 48
4		0	1	0						c 49
5		0	1	0	0					c 50
6		0	0	1	0					c 51
7		0	0	0	1					c 52
8		0	1	0	0					c 53
9		0	0	1	0	0				c 54
10		0	0	0	0	1				c 55
11		0	0	0	1	0				c 56
12		0	0	0	0	0	1			c 57
13		0	0	0	0	1	0			c 58
14		0	0	1	0	0	0			c 59
15		0	1	0	0	0	0			c 60
16		0	0	1	0	0	0			c 61

Visual Sequential Memory (VSM)

		A	B	C	D	E	F	G	c 62-77	
Item 1	response = 0 or 1	0	1						☐	c 62
2		1	0						☐	c 63
3		0	1	0					☐	c 64
4		0	0	1					☐	c 65
5		1	0	0					☐	c 66
6		0	0	1	0				☐	c 67
7		1	0	0	0				☐	c 68
8		0	1	0	0				☐	c 69
9		0	0	0	1				☐	c 70
10		0	0	0	1				☐	c 71
11		1	0	0	0				☐	c 72
12		0	0	0	1				☐	c 73
13		0	0	0	1				☐	c 74
14		0	0	1	0				☐	c 75
15		0	0	0	1				☐	c 76
16		0	1	0	0				☐	c 77

Visual Spatial Processing Aspects

VSR (c 78 - 93) + P-S (c 94 - 109) = c 78 - 109

Visual Spatial Relationships

		A	B	C	D	E	F	G	c 78-93	
Item 1	response = 0 or 1	0	1						☐	c 78
2		1	0						☐	c 79
3		0	1						☐	c 80
4		0	1						☐	c 81
5		1	0	0					☐	c 82
6		0	0	1					☐	c 83
7		1	0	0					☐	c 84
8		0	0	1					☐	c 85
9		0	0	1	0	0			☐	c 86
10		0	0	0	1	0			☐	c 87
11		1	0	0	0	0			☐	c 88
12		0	0	0	1	0			☐	c 89
13		0	0	0	0	1	0	0	☐	c 90
14		0	0	1	0	0	0	0	☐	c 91
15		0	0	0	0	1	0	0	☐	c 92
16		1	0	0	0	0	0	0	☐	c 93

Position-in-Space (P-S)

		A	B	C	D	E	F	G	c 94-109	
Item 1	response = 0 or 1	0	1	0					☐	c 94
2		0	0	1					☐	c 95
3		0	1	0					☐	c 96
4		0	0	1					☐	c 97
5		0	0	1	0				☐	c 98
6		1	0	0	0				☐	c 99
7		1	0	0	0				☐	c 100
8		0	0	0	1				☐	c 101
9		0	0	0	0	1			☐	c 102
10		1	0	0	0	0			☐	c 103
11		0	0	0	1	0			☐	c 104
12		0	1	0	0	0			☐	c 105
13		0	1	0	0	0	0	0	☐	c 106
14		0	0	0	0	0	0	1	☐	c 107
15		0	0	0	1	0	0	0	☐	c 108
16		0	0	0	0	1	0	0	☐	c 109

Visual Analysis Aspects

VC (c 110-125) + VF-G (c126-141) + VA/S (c 142-157) = c 110-157

Visual Closure (VC)		A	B	C	D	E	F	G	c 110-125	
Item 1	response = 0 or 1	0	1							c 110
2		1	0							c 111
3		1	0							c 112
4		0	1							c 113
5		0	0	1						c 114
6		0	0	1						c 115
7		1	0	0						c 116
8		0	1	0						c 117
9		0	0	0	1	0				c 118
10		0	1	0	0	0				c 119
11		0	0	0	1	0				c 120
12		0	1	0	0	0				c 121
13		0	0	0	0	1	0	0		c 122
14		0	0	0	0	1	0	0		c 123
15		1	0	0	0	0	0	0		c 124
16		0	0	0	0	0	1	0		c 125

Visual Figure-Ground (VFG)		A	B	C	D	E	F	G	c 126 -141	
Item 1	response = 0 or 1	0	1							c 126
2		0	1							c 127
3		0	1							c 128
4		1	0							c 129
5		0	0	1						c 130
6		1	0	0						c 131
7		0	0	1						c 132
8		0	1	0						c 133
9		0	0	0	1	0				c 134
10		0	0	1	0	0				c 135
11		1	0	0	0	0				c 136
12		0	0	0	0	1				c 137
13		0	0	0	0	0	1	0		c 138
14		0	0	0	0	1	0	0		c 139
15		0	0	0	0	0	0	1		c 140
16		0	0	1	0	0	0	0		c 141

Visual Analysis and Synthesis (VA/S)		A	B	C	D	E	F	G	c142-157	
Item 1	response = 0 or 1	1	0							c 142
2		0	1							c 143
3		1	0							c 144
4		1	0							c 145
5		0	1	0						c 146
6		0	0	1						c 147
7		1	0	0						c 148
8		0	0	1						c 149
9		0	0	1	0	0				c 150
10		0	0	0	0	1				c 151
11		0	0	0	1	0				c 152
12		0	0	1	0	0				c 153
13		0	0	0	1	0	0	0		c 154
14		0	0	0	1	0	0	0		c 155
15		0	0	1	0	0	0	0		c 156
16		0	0	0	0	1	0	0		c 157

Achievement Performance

Reading

Performance has not satisfied the requirements of Learning Area	1		
Performance has partially satisfied the requirements of Learning Area	2		
Performance has satisfied the requirements of Learning Area	3		
Performance has exceeded the requirements of Learning Area	4		
Performance has far exceeded the requirements of Learning Area	5	☐	c 158

Spelling

Performance has not satisfied the requirements of Learning Area	1		
Performance has partially satisfied the requirements of Learning Area	2		
Performance has satisfied the requirements of Learning Area	3		
Performance has exceeded the requirements of Learning Area	4		
Performance has far exceeded the requirements of Learning Area	5	☐	c 159

Mathematics

Performance has not satisfied the requirements of Learning Area	1		
Performance has partially satisfied the requirements of Learning Area	2		
Performance has satisfied the requirements of Learning Area	3		
Performance has exceeded the requirements of Learning Area	4		
Performance has far exceeded the requirements of Learning Area	5	☐	c 160

Intellectual Functioning - SSAIS-R

130 -	Very Superior
120 - 129	Superior
110 - 119	High Average
90 - 109	Low Average

Full scaled IQ ☐☐☐ c 161-163

	Scaled score	Verbal IQ	
Verbal Tests	☐☐	☐☐☐	c 164-168

	Raw Score	Stanine	
Vocabulary	☐☐	☐	c 169-171
Comprehension	☐☐	☐	c 172-174
Similarities	☐☐	☐	c 175-177
Number Problems	☐☐	☐	c 178-180
Story Memory	☐☐	☐	c 181-183
Memory for Digits	☐☐	☐	c 184-186

	Scaled score	Nonverbal IQ	
Non-Verbal Tests	☐☐	☐☐☐	c 187-191

	Raw Score	Stanine	
Pattern Completion	☐☐	☐	c 192-194
Block Designs	☐☐	☐	c 195-197
Missing Parts	☐☐	☐	c 198-200
Form Board	☐☐	☐	c 201-203
Coding	☐☐	☐	c 204-206

☐☐☐☐ c 207-210

SUBTEST: VISUAL DISCRIMINATION (VD) **VISUAL DISCRIMINATORY ASPECTS**

(*Similar Test: Gardiner's TVPS: Subtest - Visual Discrimination*)

Task: To locate the exact two or three dimensional (2- 3D) view of a form (the target item) in the midst of other represented form views (the response items).

Purpose: To evaluate the learner's ability to observe swiftly, as well as accurately, concrete differences and/or similarities in presented 2- or 3D printed form views represented on blue paper.

Over and above: requires visual attention, visual scanning, reasoning and motor planning (to point to an elected response item) aspects

Ceiling: Three consecutive unsuccessful responses

Time Allocation: 2 to 9 seconds (taking into account the learner's age and the item's level of difficulty)

Material:

- ✓ 3D plastic shapes: one oval and two circles
- ✓ Test Booklet containing 16 Visual Discrimination (VD) Plates

Procedure:

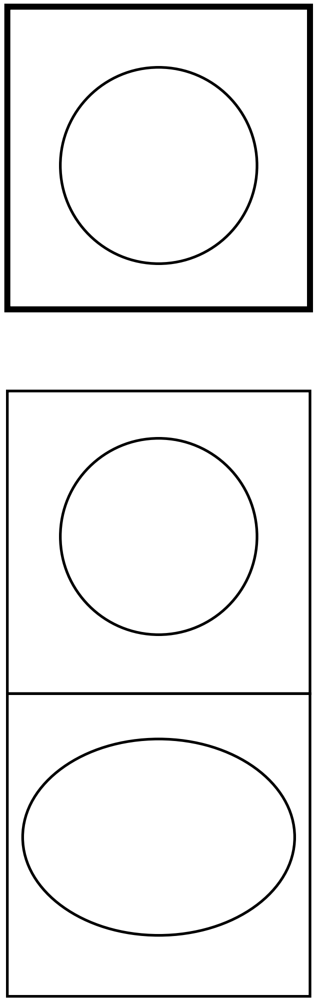
❖ **Concrete Example: plastic 3-dimensional shapes (an oval and two circles of the same colour)**

Instructions: The tester places an oval and two circles, which are the same in colour vertically in front of the learner. Say to the learner, **"See this shape…"** (whilst **pointing to a circle)** **"…look and find it amongst these"** (whilst **pointing to the remaining shapes** [one circle and an oval] on the table). If learner selects the circle say, **"Yes, it is exactly the same… same shape, size and colour."** If learner is unsuccessful take time to explain what makes the two circles similar (i.e. the colour, shape and size) as well as what makes the oval differ to the circle.

❖ **Test Booklet: 16 VD Plates – 2- or 3D represented views of black stimuli on blue paper arranged from easy to more complicated form views**

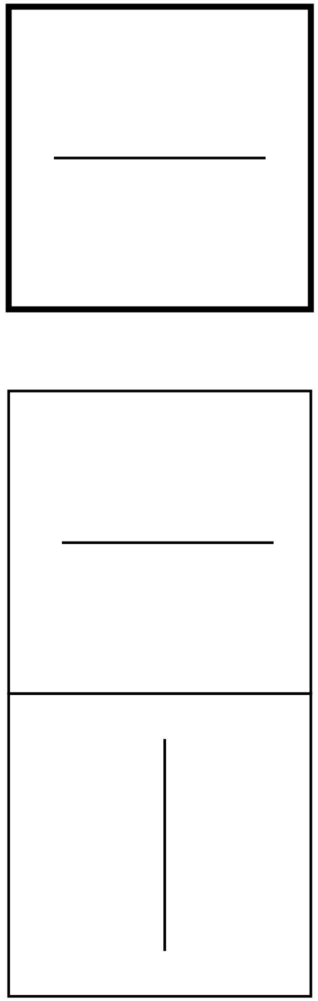
Instructions: Present the VD Test booklet by placing it in front of the learner. Open the VD Plate 1 in front of the learner. Say to the learner, **"See this form…"** (whilst **placing the circle** on the plate's target item) **"…see that it is the same as the one drawn on this paper?"** Remove the circle. Say to the learner, **"See this form in this block…"** (whilst **pointing to the target block** containing a the single 2D form view). Then say, **"Look and find it among these forms below."** (**pointing** now to the blocks below containing the various choices). If the learner identifies and nominates the correct response **continue** with the next plate of the VD subtest **until the ceiling is reached**. If the learner is unable to allocate the correct response, once more demonstrate the Concrete and Plate 1 Examples. Record this unsuccessful attempt on the score sheet (see score sheet example). The learner may require prompting to make a choice if more time than is considered reasonable is taken (see time allocation). Record all responses on the score sheet by either circling or crossing through the learner's elected response. This can assist with a possible diagnostic evaluation, as well as to delineate the visual perceptual aspect which may require remediation.

1



c 14

2



c 15

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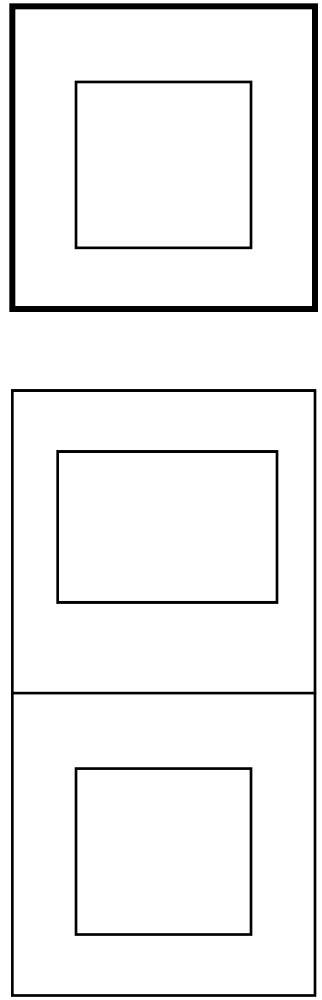
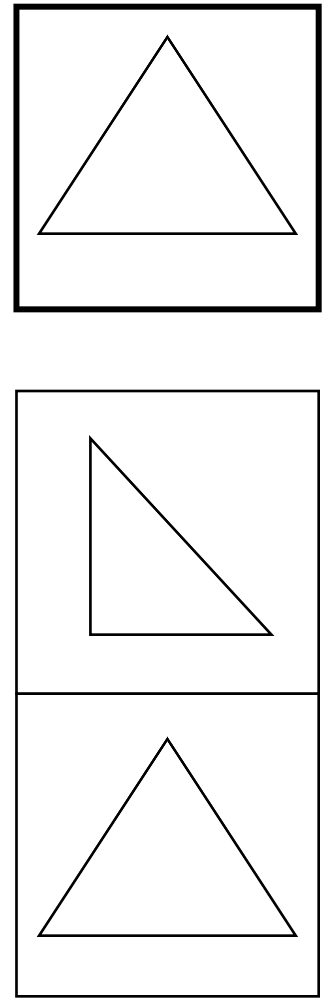


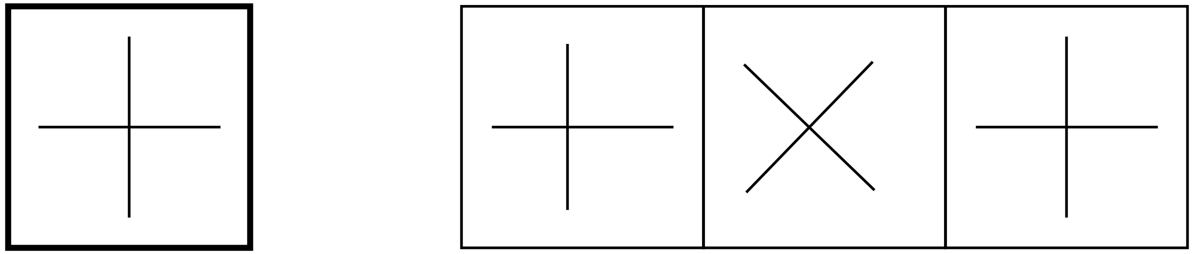
c 16

4



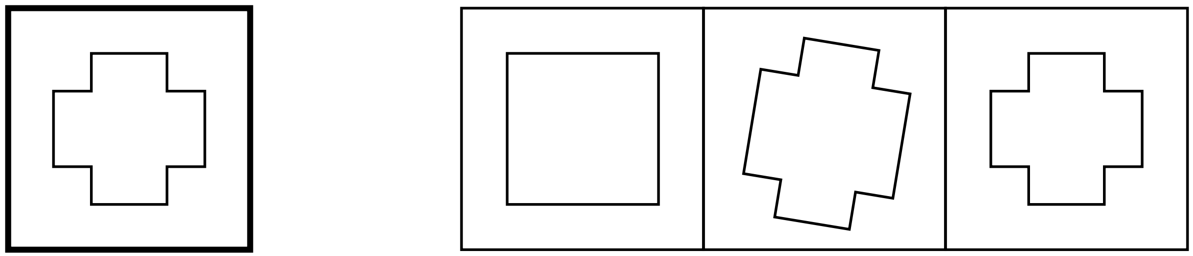
c 17

5



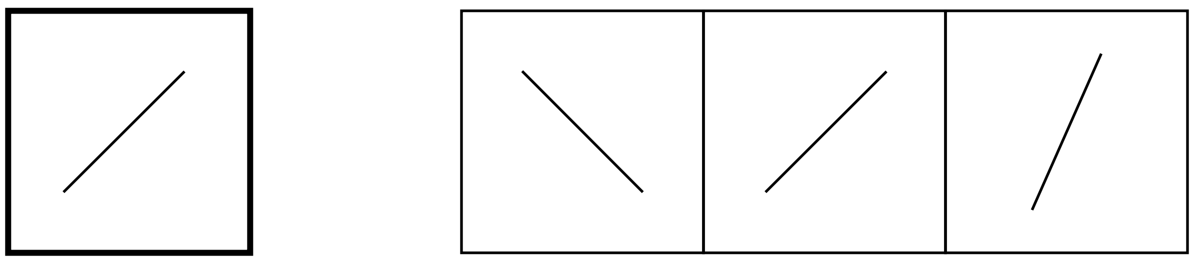
c 18

6



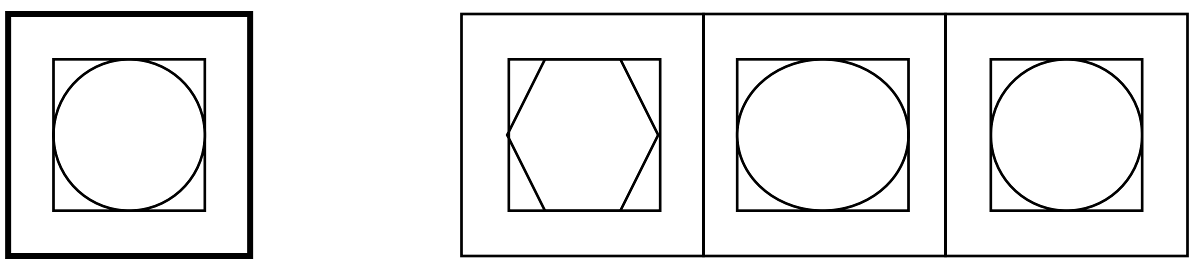
c 19

7



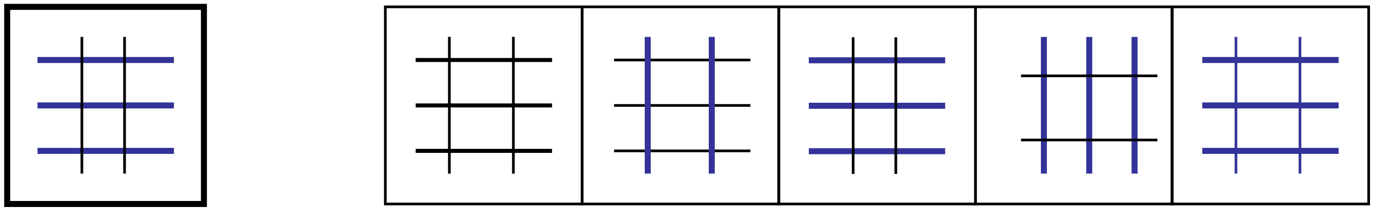
c 20

8



c 21

9



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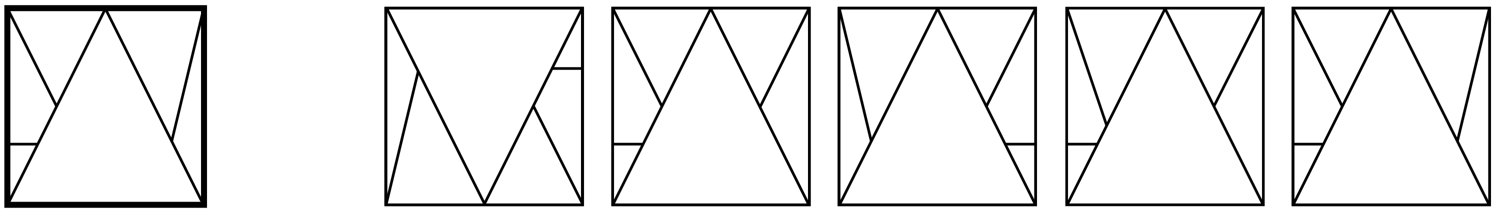

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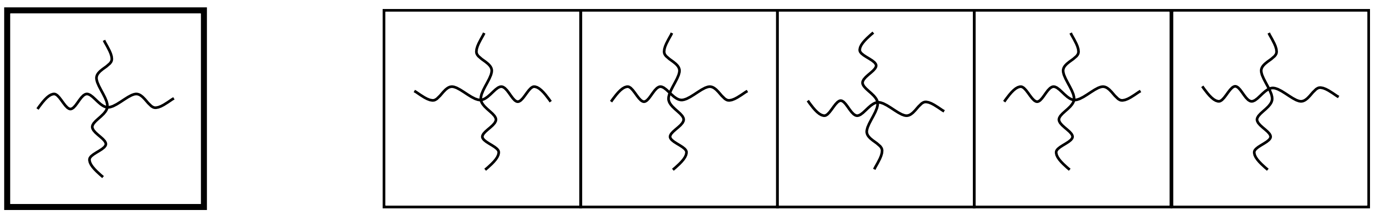

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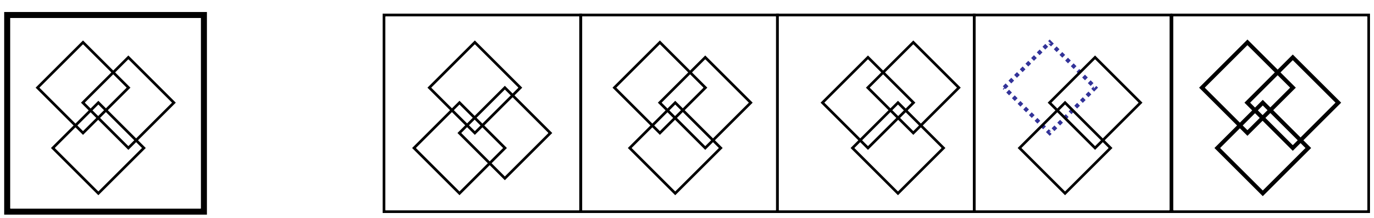

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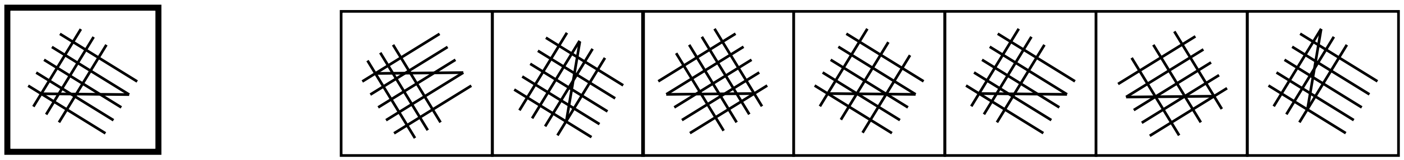

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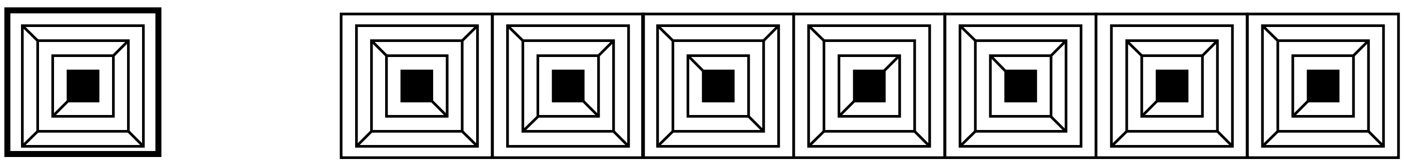

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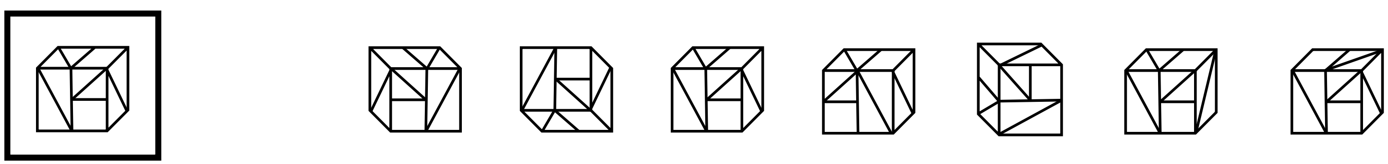

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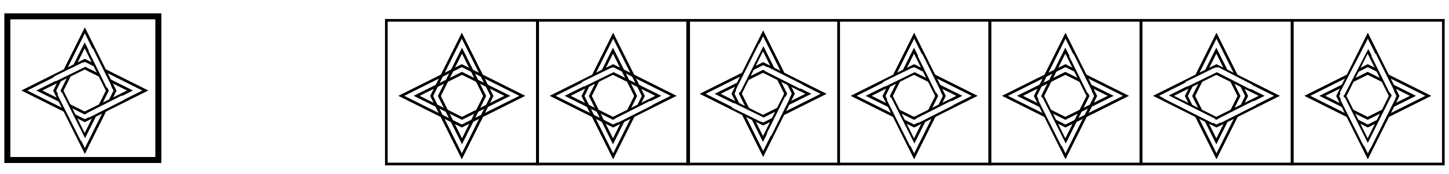

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SUBTEST: VISUAL FORM CONSTANCY (VFC) <u>VISUAL DISCRIMINATORY ASPECTS</u>

(*Similar Tests: Gardiner's TVPS: Subtest - Form Constancy; DVPT: Subtest 8 - Form Constancy*)

Task: To locate the same 2-3D view of a form even though it has changed in colour, direction or size, amongst other form views

Purpose: To locate the same form regardless of size, colour or directional orientation

Over and above: Requires visual attention, visual scanning, reasoning and comprehension

Ceiling: Three consecutive unsuccessful responses

Time allocation: 2 to 9 seconds (taking into account the learner's age and the item's level of difficulty)

Material:

- ✓ Form constancy board contain 8 (4 x 2) shapes varying in colour, size and directional orientation
- ✓ Test Booklet containing 16 Visual Form Constancy Plates

Procedure:

❖ **Concrete Example: plastic form constancy board with various shapes**

<u>Instructions</u>:

The tester places the form constancy board in front of the learner. Say to the learner, **"See this board it contains various shapes find all the shape which look like this one**" (pointing to a rectangle). Say, **"Look very carefully … remember it may have changed its size, direction or colour …"** Then say to the learner, **"…look and find any other rectangles on this board"** (whilst **pointing** to the shapes on the board**).** Say, **"Look very carefully … it may have changed its size, colour or direction".**

❖ **Test Booklet: 16 VFC Plates – 2- or 3D black stimuli on blue paper**

<u>Instructions</u>: Present the VFC Test booklet to the learner, placing it in front of the learner. Open VFC Plate 1 in front of the learner. Say to the learner, **"See this form in this block…"** (whilst **pointing to the target block** containing the single form). Then say to the learner, **"Look and find it amongst these forms."** (**pointing** now **to the blocks below** containing the choices for an elected response) Say, **"Look very carefully … remember it may have changed its size, direction or colour".** If the learner identifies the correct response **continue** with the next plate of the VFC subtest **until the ceiling is reached**. If the learner is unable to allocate the correct response, once more demonstrate the Concrete and Plate 1 Examples. Record this unsuccessful attempt on the score sheet (see score sheet example). The learner may require prompting to make a choice if more time than is considered reasonable is taken (see time allocation). Record all responses on the score sheet by either circling or crossing through the learner's elected response to later assist with a possible diagnostic evaluation and to delineate the areas required for remediation.

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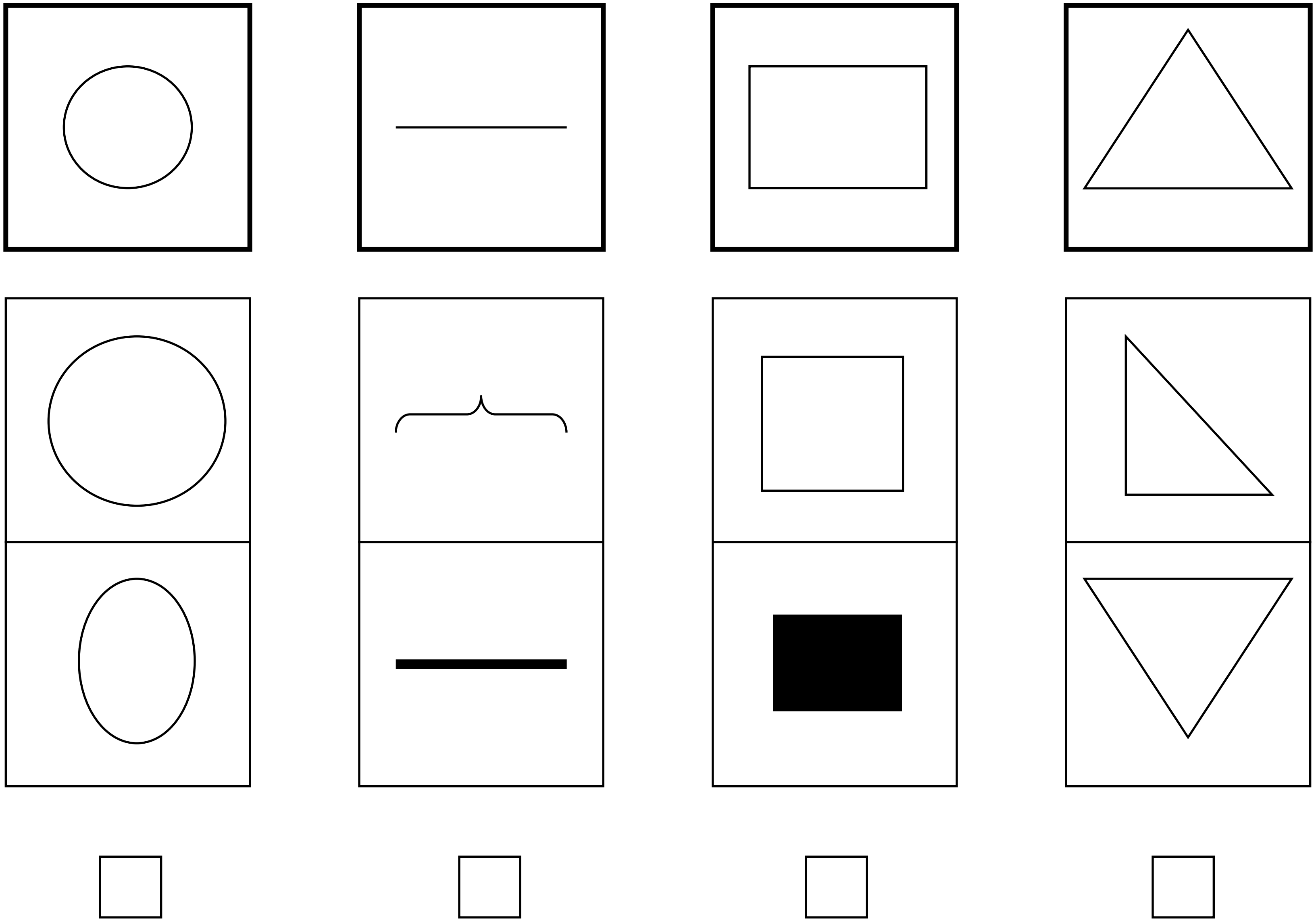

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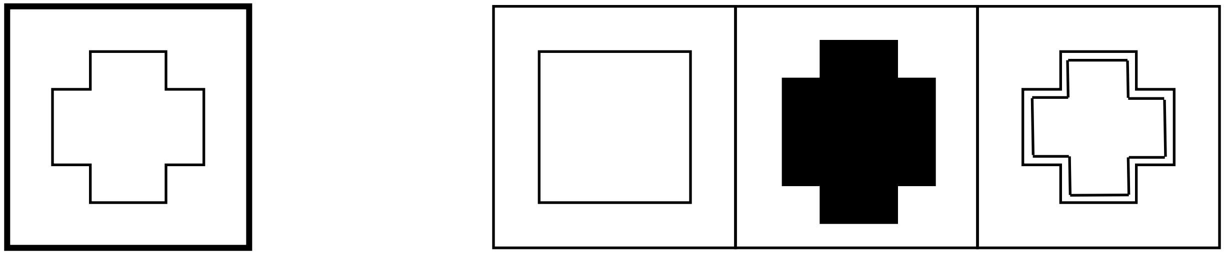

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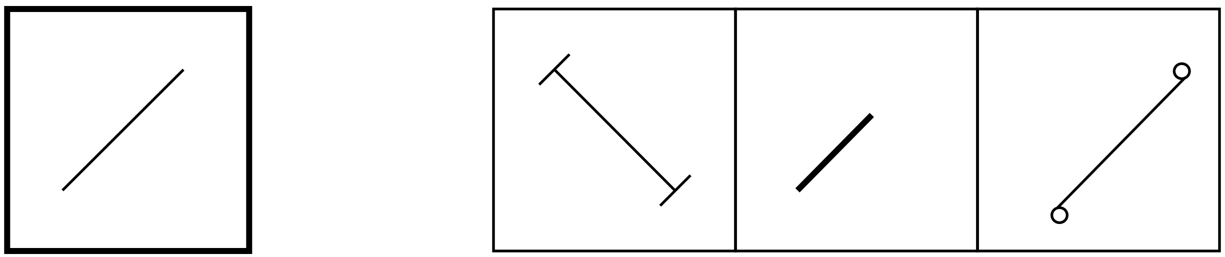

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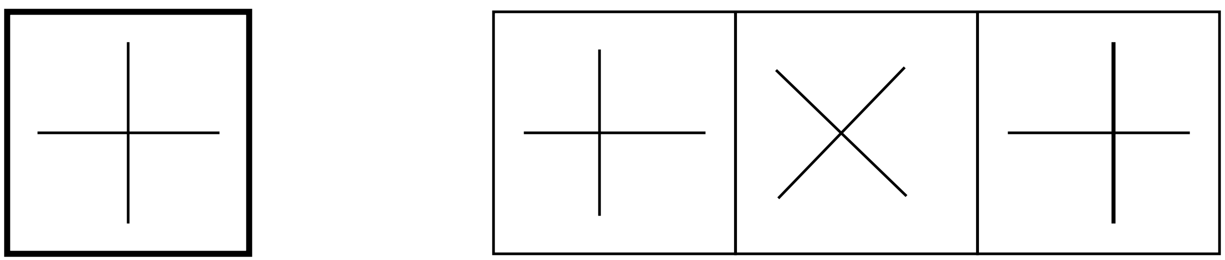

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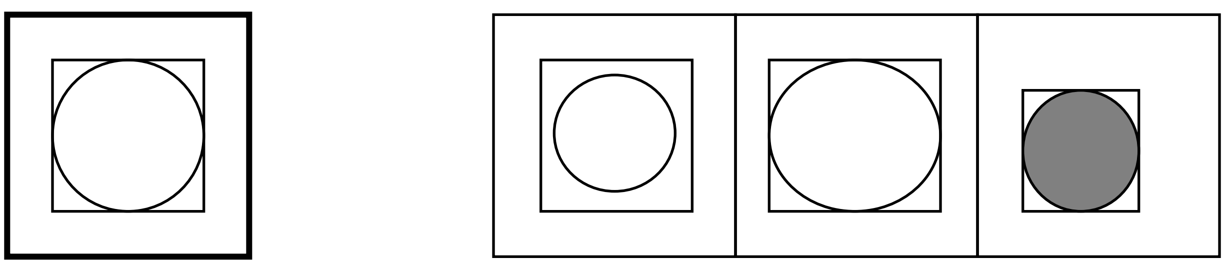

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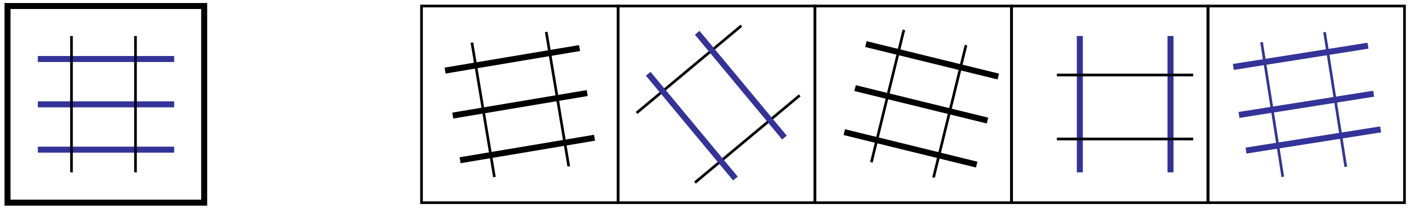
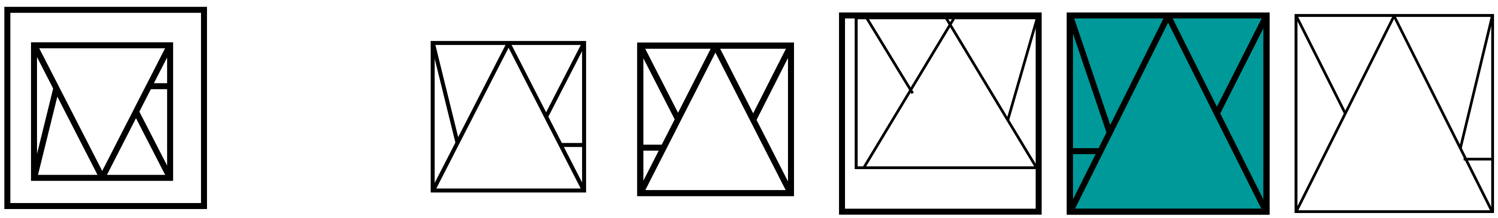
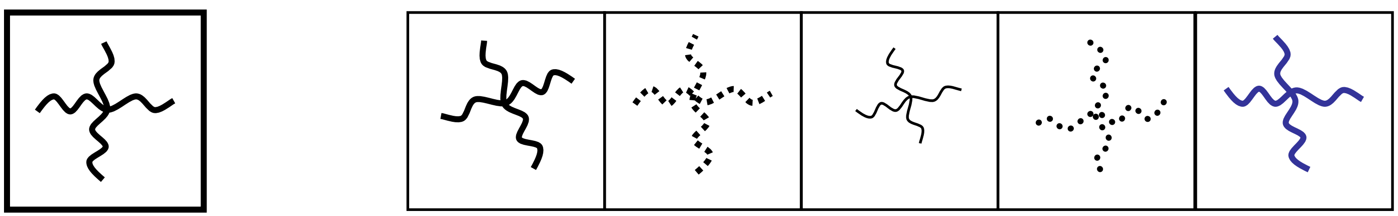
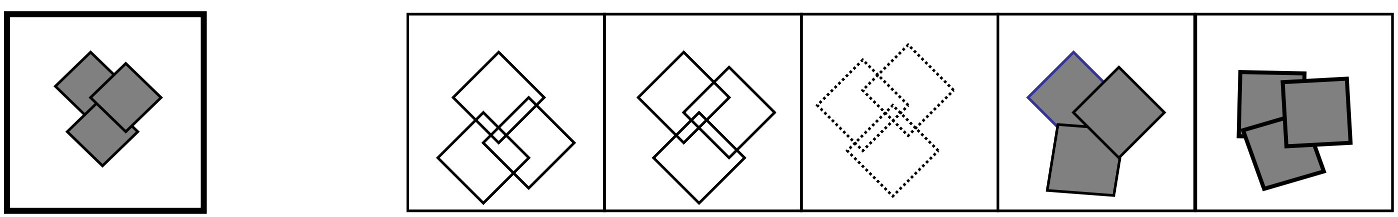
9  c 38

10  c 39

11  c 40

12  c 41

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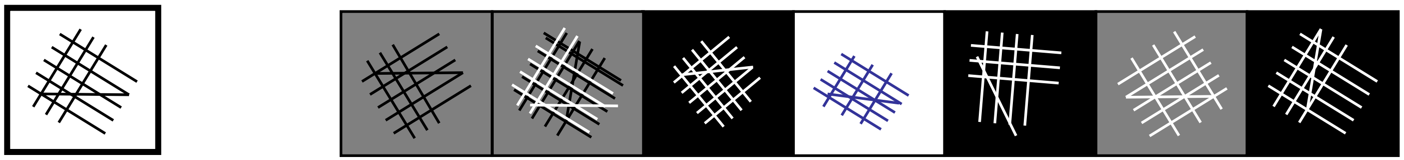

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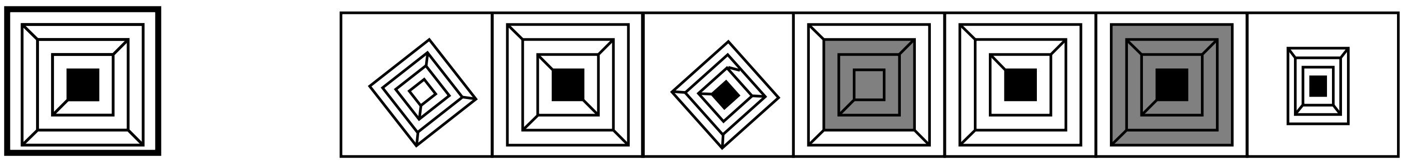

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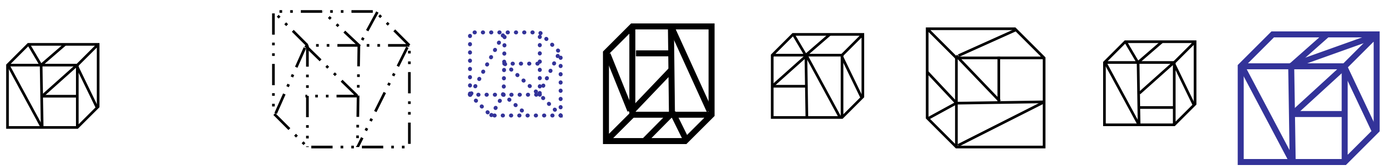

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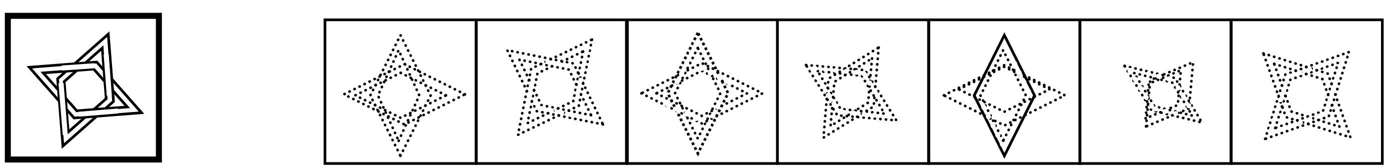

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SUBTEST: VISUAL MEMORY (VM)

(*Similar Test: Gardiner's TVPS – Subtest: Visual Memory*)

Task: To identify and hold a 2- or 3 D represented form view in the working memory

Purpose: To evaluate the learner's ability to remember and to recognise and recall a visually presented 2- or 3D form view

Over and above: requires visual attention, visual scanning, reasoning and comprehending

Ceiling: Three consecutive unsuccessful responses

Time Allocation: 8 seconds for younger learners and 4 to 5 seconds for older learners

Material:

- ✓ 3D plastic shapes: the same coloured square and triangle shapes
- ✓ Test Booklet containing 32 Visual Memory Plates

Procedure:

❖ **Concrete Example: plastic 3-dimensional shapes (triangle and square)**

Instructions:

The tester places the triangle on the table in front of the learner. Say to the learner, **"See this shape… look carefully you must remember it so that you can find it again…"** (whilst **pointing to the shape).** Allow the learner time to view the shape (see time allocation) before removing it. Then say, **"…which shape did I show you"** (whilst **placing both shapes** [square and triangle] on the table in front of the learner).

❖ **Test Booklet: 32 VM Plates - 2D black stimuli on blue paper**

Instructions:

Place the VM Test booklet in front of the learner. Open VM Plate 1 in front of the learner. Say to the learner, **"See this form… look carefully as you must remember it so that you can find it on the next page…"** (whilst **pointing to the single target form** on the plate). After you have returned the page say, **"… look and find it between these forms"** (whilst **pointing to the choice of response items** on the plate). Allocated time for the learner to view the design (see time allocation above). If the learner identifies and nominates the correct response **continue** with the next plate of the VM subtest **until the ceiling is reached**.

If the learner is unable to allocate the correct response, once more demonstrate the Concrete and Plate 1 Examples. Record this unsuccessful attempt on the score sheet (see score sheet example). The learner may require prompting to make a choice if more time than is considered reasonable is taken (see time allocation). Remember a majority of learners will can require allocated time, then proceed at the pace set by the individual learner. Record all responses on the score sheet by either circling or crossing through the learner's elected response to later assist with a possible diagnostic evaluation.

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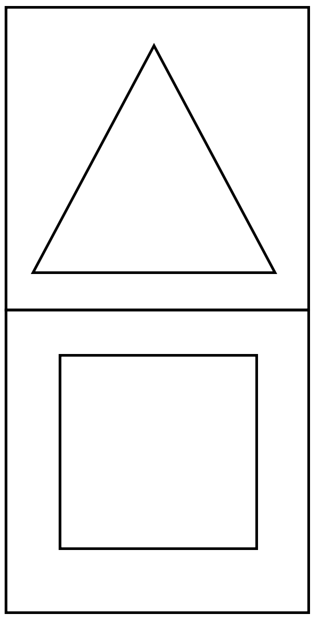

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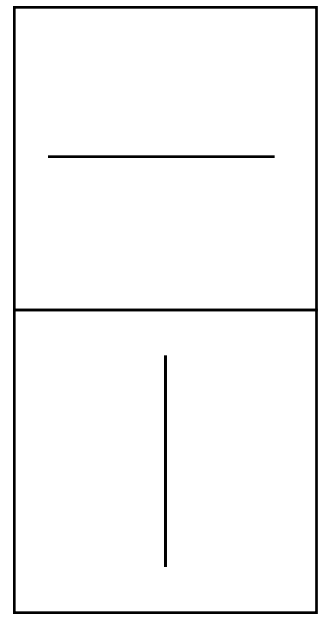

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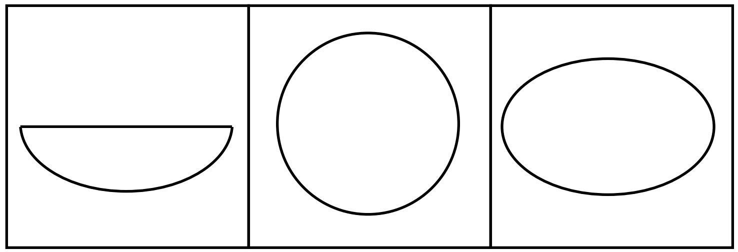

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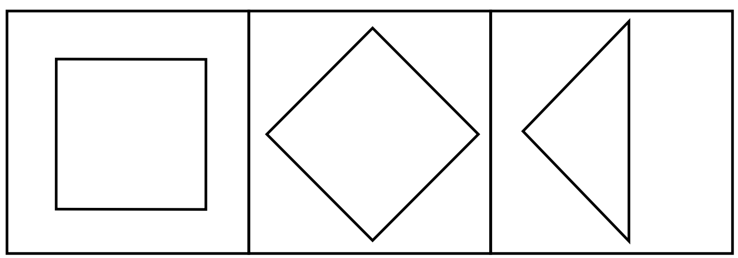

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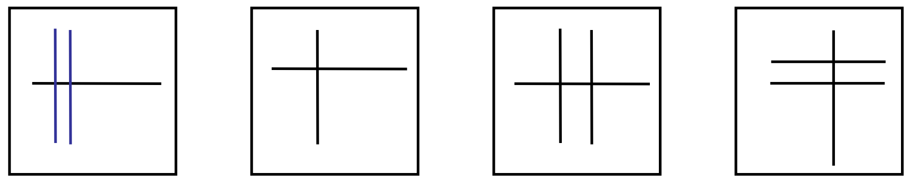

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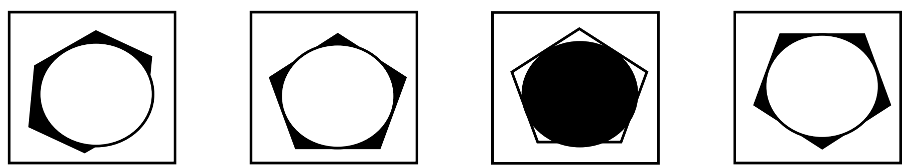

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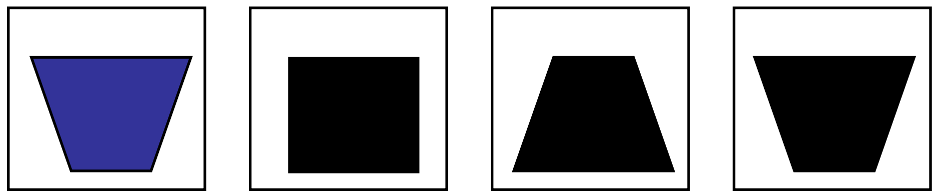

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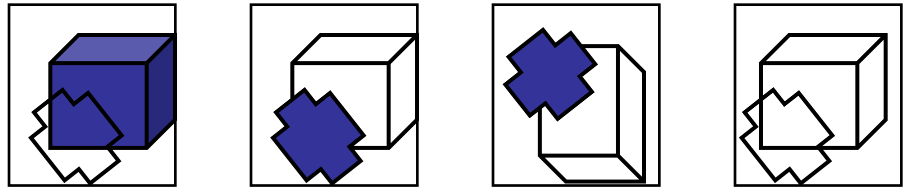

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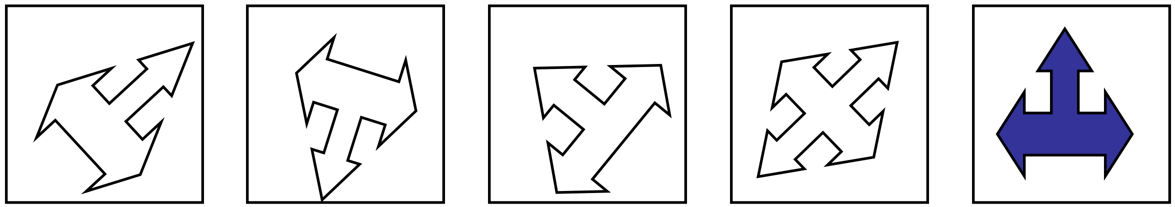

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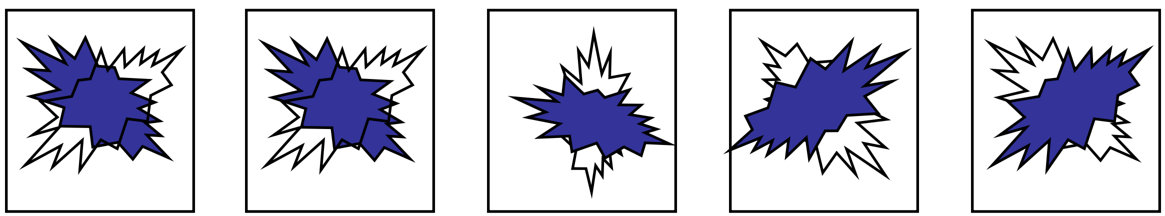

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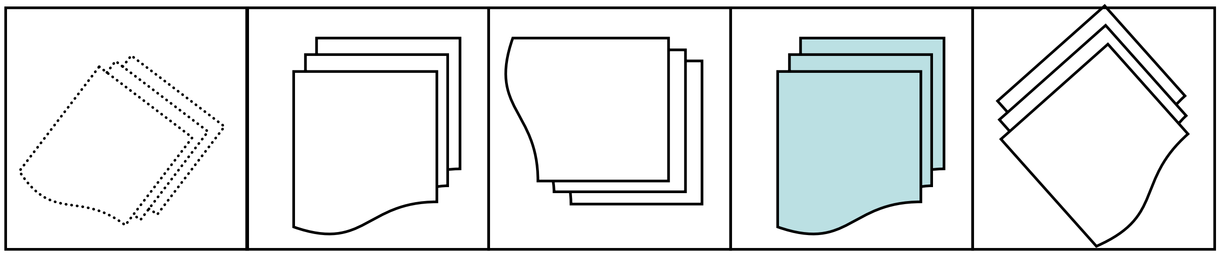

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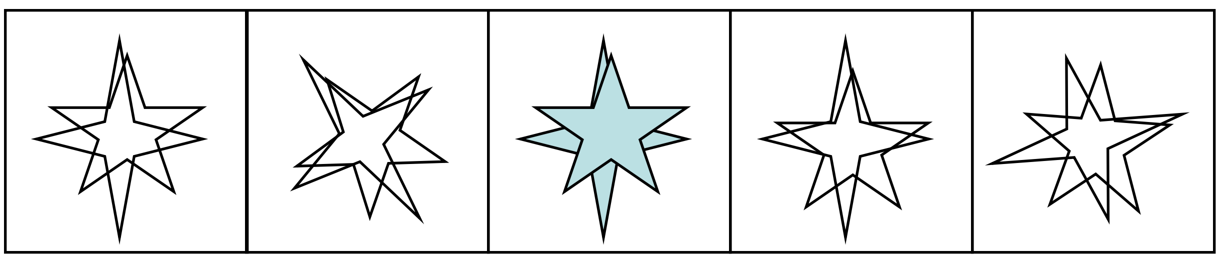

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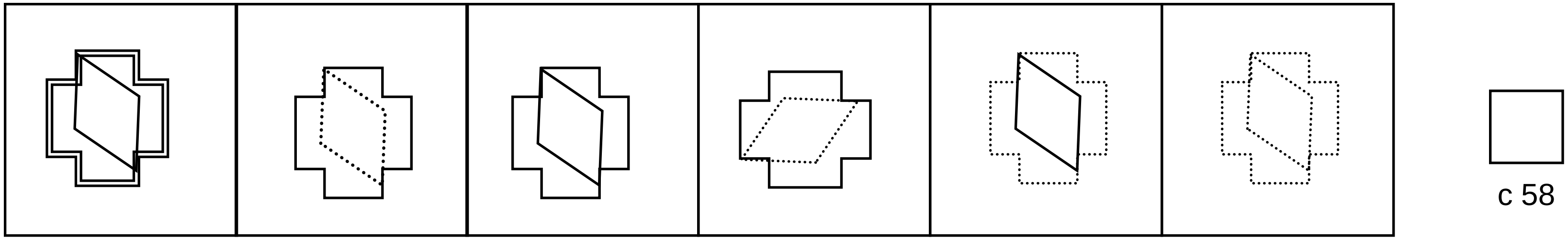

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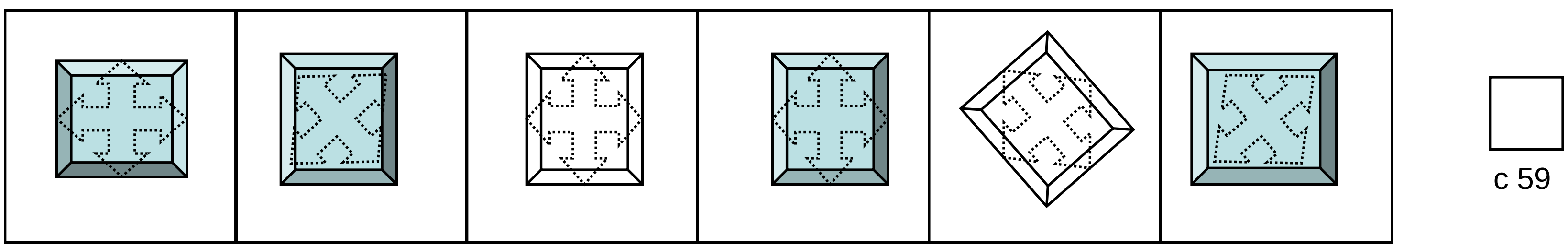

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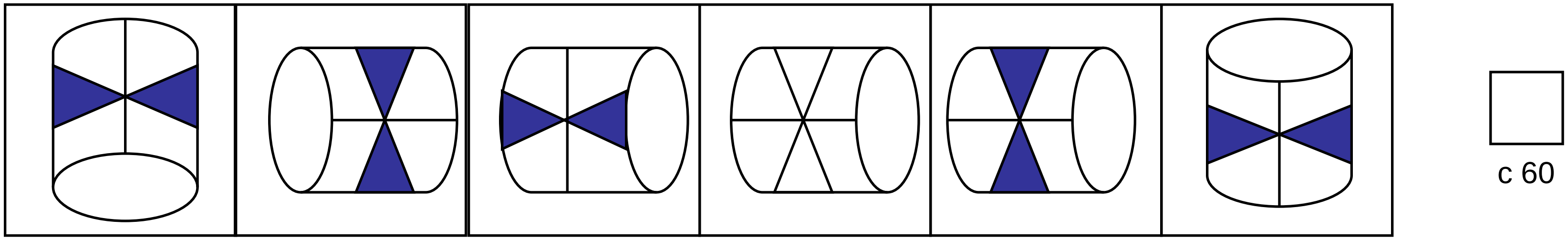

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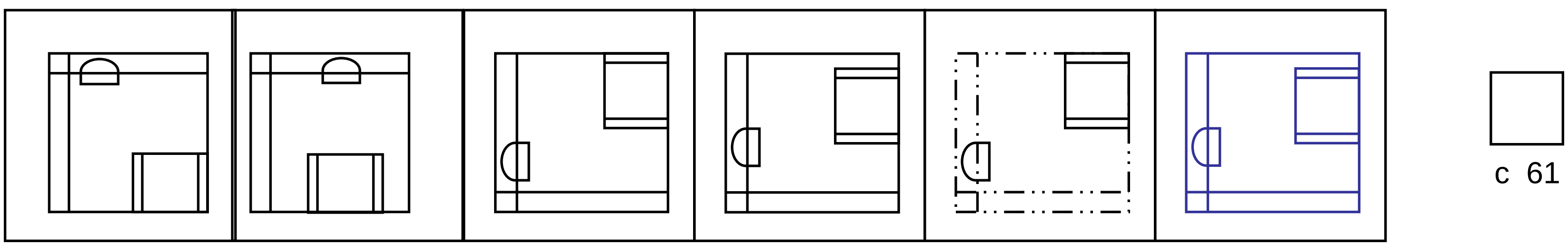

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SUBTEST: VISUAL SEQUENTIAL MEMORY (VSM) **VISUAL MEMORY ASPECTS**

(*Similar Tests: Gardiner's TVPS – Subtest: Visual Sequential Memory, ITPA*'s V*isual Sequential Memory Subtest*)

Task:	To identify and hold a 2- or 3 D represented sequential pattern of forms in the working memory to be able to accurately recall it	
Purpose:	To evaluate the learner's ability to remember a non meaningful sequential pattern of a visual stimuli previously seen	
Over and above:	Requires visual attention, visual scanning, reasoning, comprehending and planning	
Ceiling:	Three consecutive unsuccessful responses	
Time Allocation:	5 seconds for 2 to 3 sequential forms (items 1 - 5;	12 seconds for 6 to 7 sequential forms (items 10 – 13)
	9 seconds for 4 to 5 sequential forms (items 6 - 9)	14 seconds for 8 to 9 sequential forms (items 14 - 16)
Time Prod:	6 to 10 seconds (taking into account the learner's age and the item's difficulty)	
Material:		

- ✓ 3D plastic shapes: the same coloured circle and cross shapes
- ✓ Test Booklet containing 32 Visual Memory Plates

Procedure:

❖ **Concrete Example: plastic 3-dimensional shapes (circle, and two cross shapes)**

Instructions: The tester builds a form pattern (i.e. x o x) on the table in front of the learner. Say to the learner, **"See this pattern of shapes… look carefully as you must remember it so that you can copy it…"** (whilst **pointing to the pattern of shapes).** Allow the learner time to view the shape before removing it. Then say, **"…build the pattern you saw"** (whilst **placing the removed shapes** back on the table in front of the learner).

❖ **Test Booklet: 32 VSM Plates - 2D black stimuli on blue paper**

Instructions: Place the VSM Test booklet it in front of the learner. Open VSM Plate 1 in front of the learner. Say to the learner, **"See this pattern… look carefully as you must remember it, so that you can find it on the next page…"** (whilst **pointing to the single target form** on the plate). After you have returned the page say, **"… look and find the same pattern"** (whilst **pointing to the choice of response items** on the plate). Allocated time for the learner to view the design (see time allocation above). If the learner identifies and nominates the correct response **continue** with the next plate of the VSM subtest **until the ceiling is reached**. If the learner is unable to allocate the correct response, once more demonstrate the Concrete and Plate 1 Examples. Record this unsuccessful attempt on the score sheet (see score sheet example). The learner may require prompting to make a choice if more time than is considered reasonable is taken (see time allocation). Remember a majority of learners will require less allocated time, then proceed at the pace set by the individual learner. Record all responses on the score sheet by either circling or crossing through the learner's elected response to later assist with a possible diagnostic evaluation.

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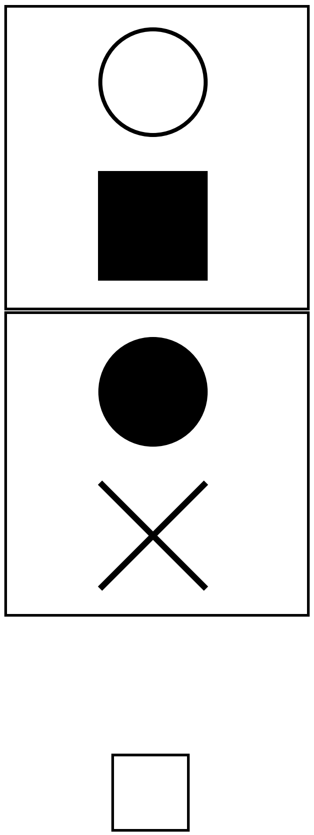

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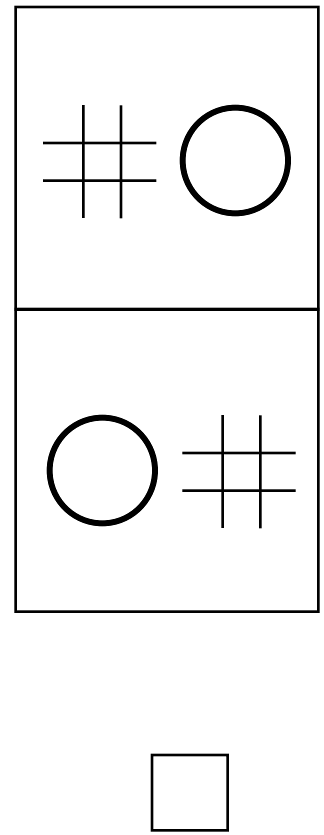

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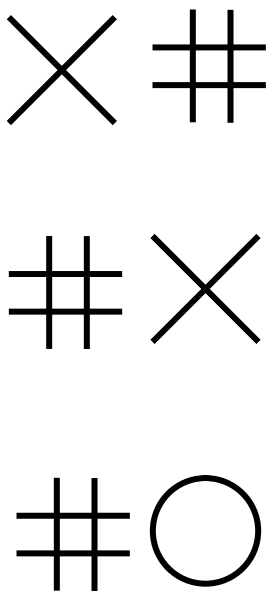

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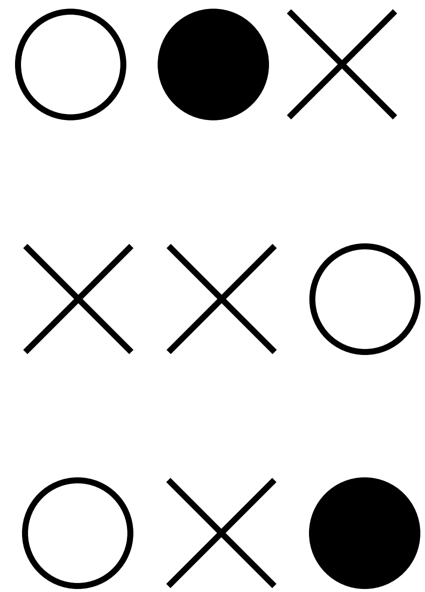

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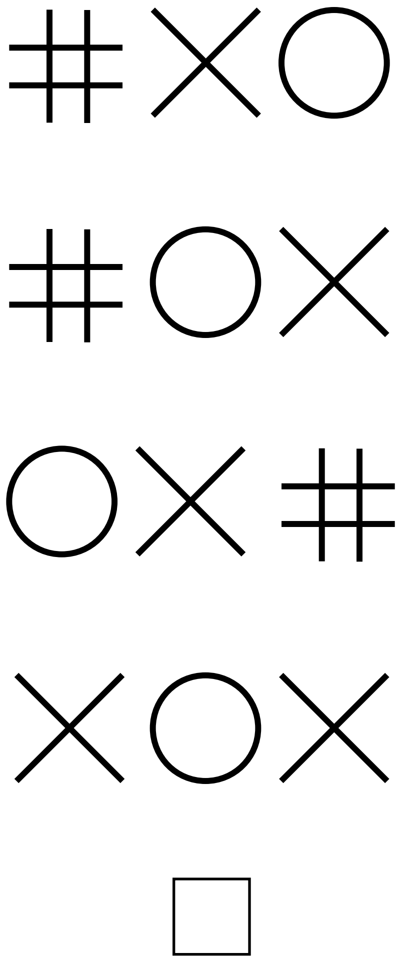

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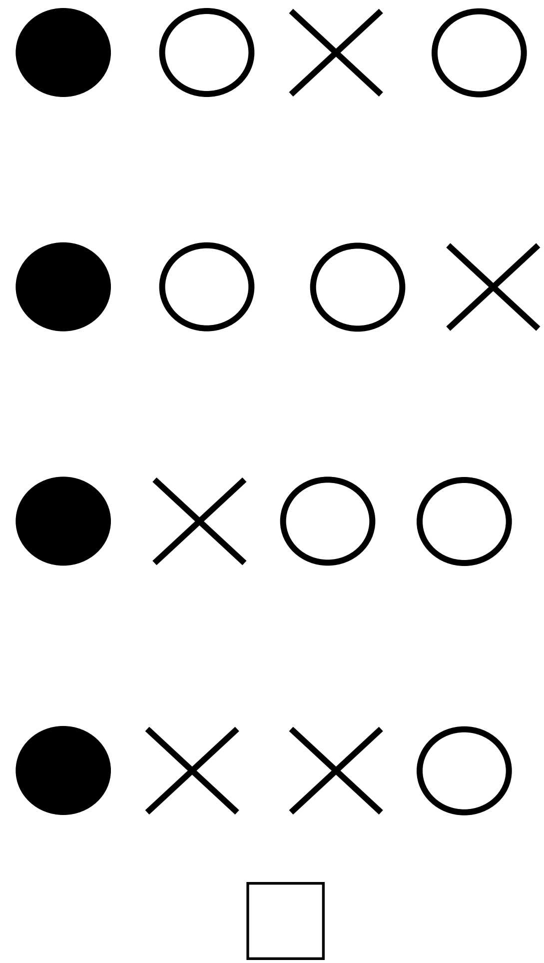

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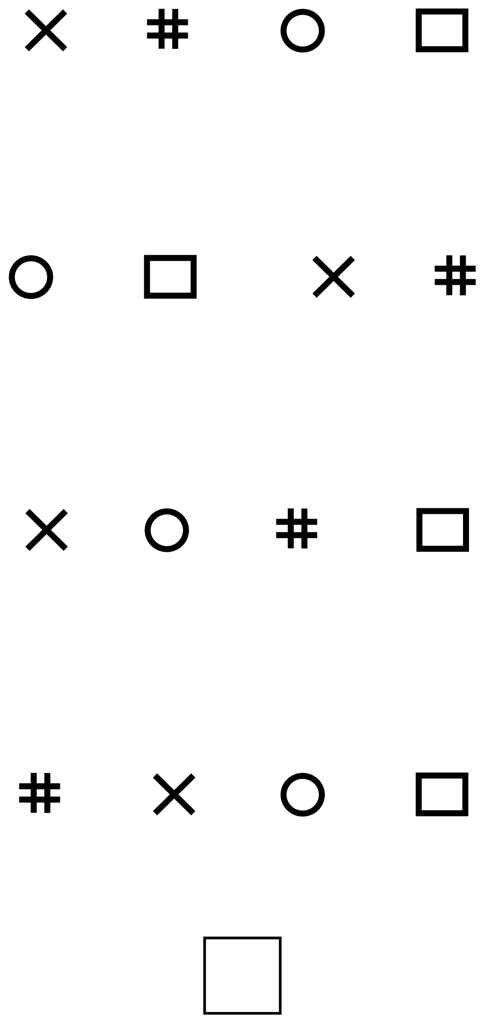

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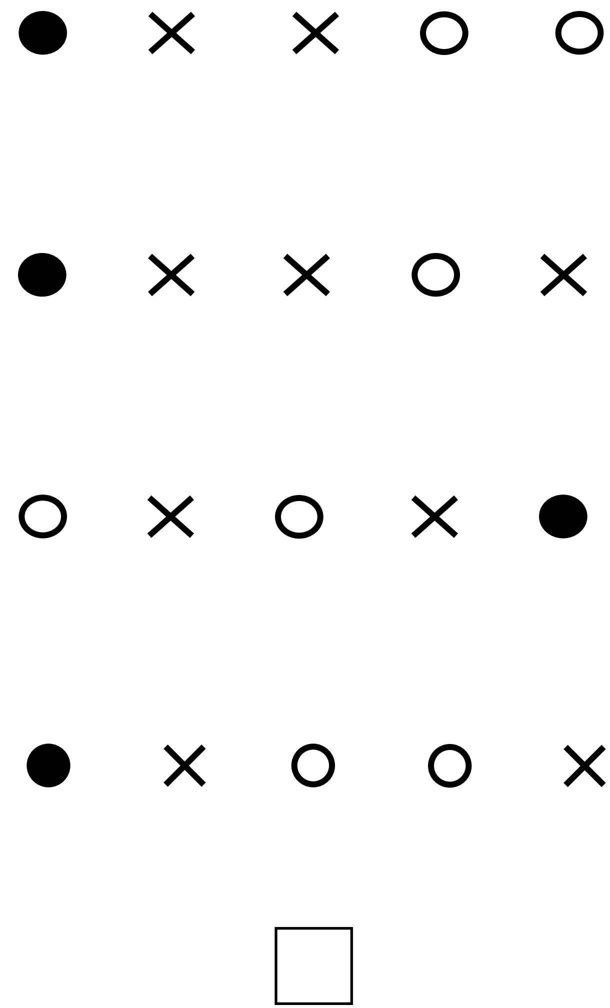

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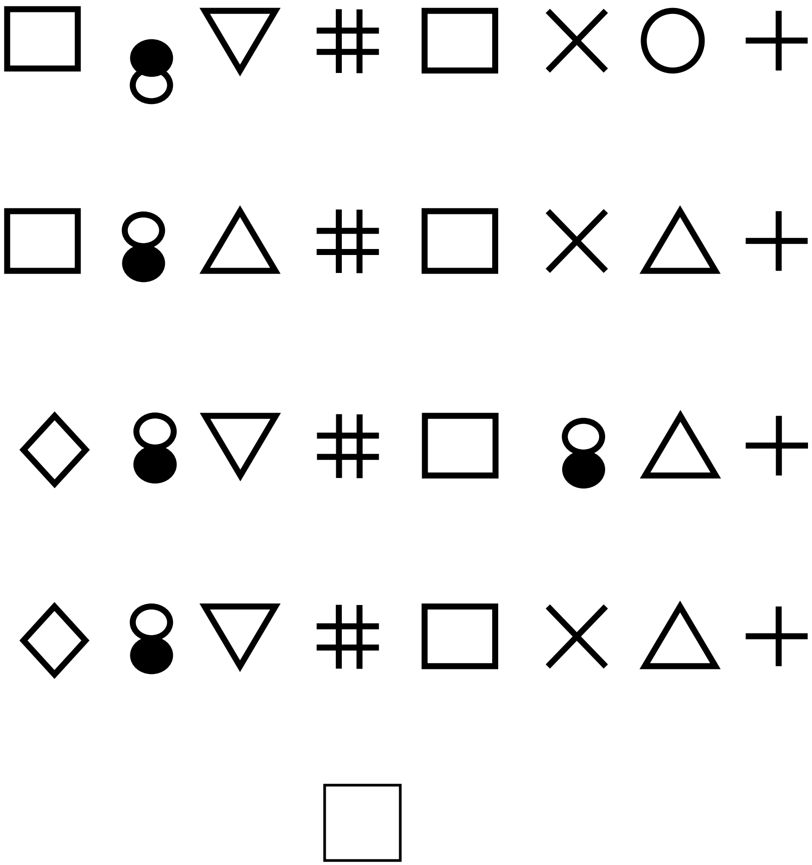

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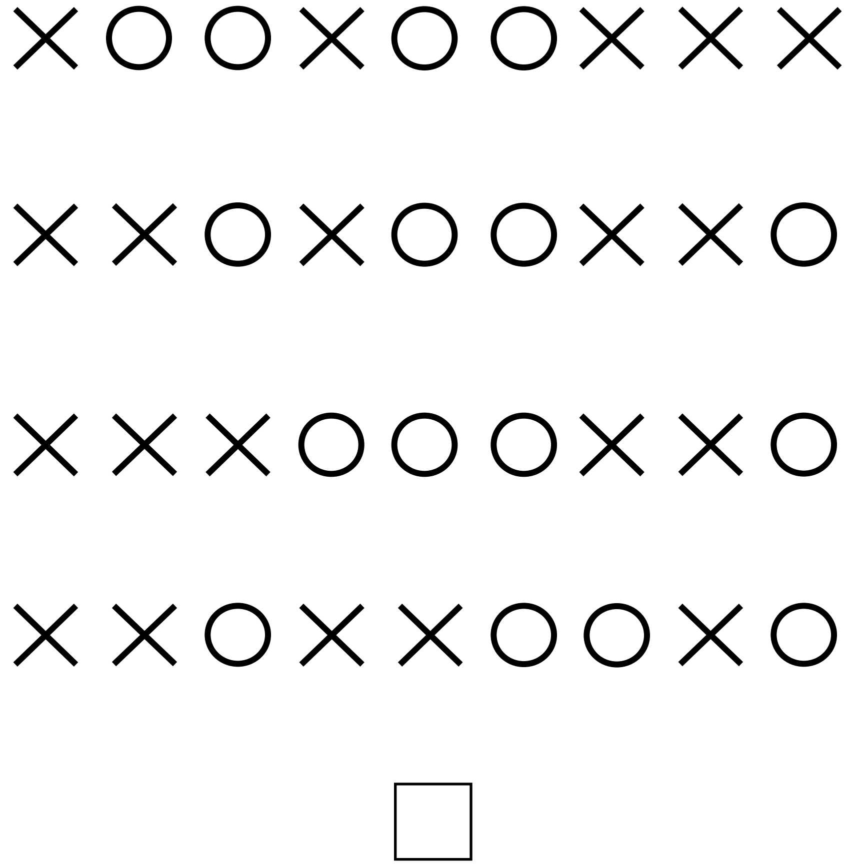

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SUBTEST: VISUAL SPATIAL RELATIONSHIPS (VSR) <u>VISUAL SPATIAL PROCESSING ASPECTS</u>

(*Similar Tests: SSAIS-R: Subtest Pattern Completion; Gardiner's TVPS: Subtest Visual Spatial Relationship*)

Task: To locate a 2- or 3D view of a form which presents in a different directional orientation amongst a choice of other presented form views

Purpose: To evaluate the learner's ability to be aware of the directional orientation of forms

Over and above: Requires visual attention, visual scanning, directionality, reasoning and comprehension

Ceiling: Three consecutive unsuccessful responses

Time Allocation: 2 to 9 seconds (taking into account the learner's age and the item's level of difficulty)

Material:

- ✓ 3D Shapes: four triangles
- ✓ Test Booklet containing 16 Visual Spatial Relationship Plates

Procedure:

❖ **Concrete Example: four plastic 3-dimensional triangle shapes**

<u>Instructions</u>:

The tester places a row of triangles in front of the learner in an array of different directional positions (i.e. ←↑→↓). Say to the learner, **"See these forms are the same shape…"** (whilst **pointing to a triangle).** Then say, **"…but look how they can change the way that they point"** (whilst **pointing** to the remaining triangles on the table and **remarking** on their directional position) For example, **"This one is pointing to the top; is pointing to the side, is pointing to the bottom".**

❖ **Test Booklet: 16 VSR Plates – 2- or 3D represented views of black stimuli on blue paper**

<u>Instructions</u>:

Present the VSR Test booklet to the learner, placing it in front of the learner. Open VSR Plate 1 in front of the learner. Say to the learner, **"Here are the exact same forms, but one is going in a different way…"** (whilst **pointing** to the responses) **"… look and find the one which is going in a different direction."** If the learner identifies the correct response **continue** with the next plate of the VSR subtest **until the ceiling is reached**.

If the learner is unable to allocate the correct response, once more demonstrate the Concrete and Plate 1 Examples. Record this unsuccessful attempt on the score sheet. The learner may require prompting to make a choice if the learner takes more time than is considered reasonable (see time allocation). Record all responses on the score sheet by either circling or crossing through the learner's elected response to later assist with a possible diagnostic evaluation.

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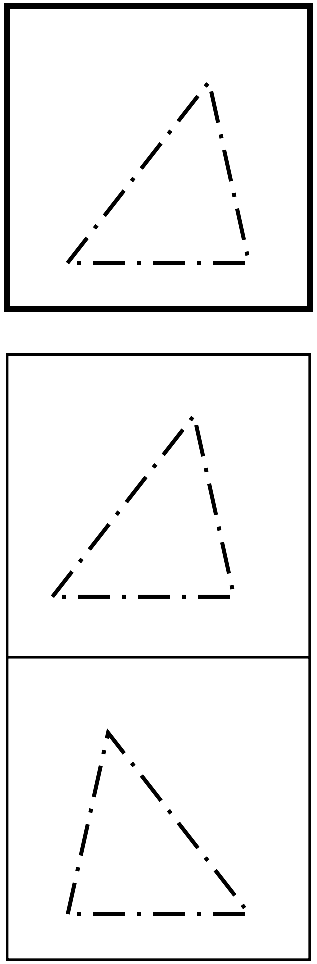

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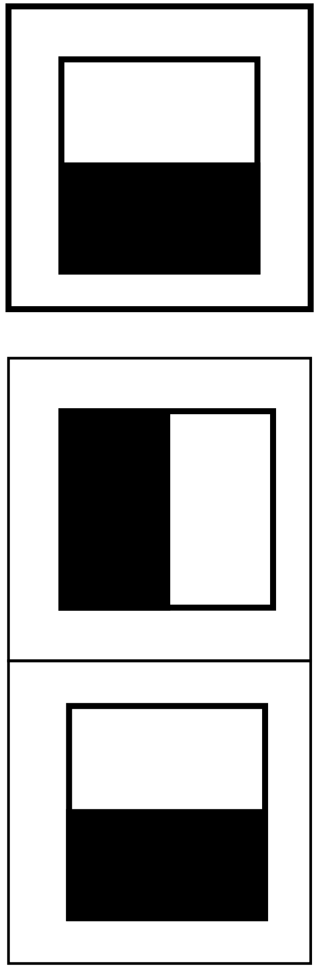

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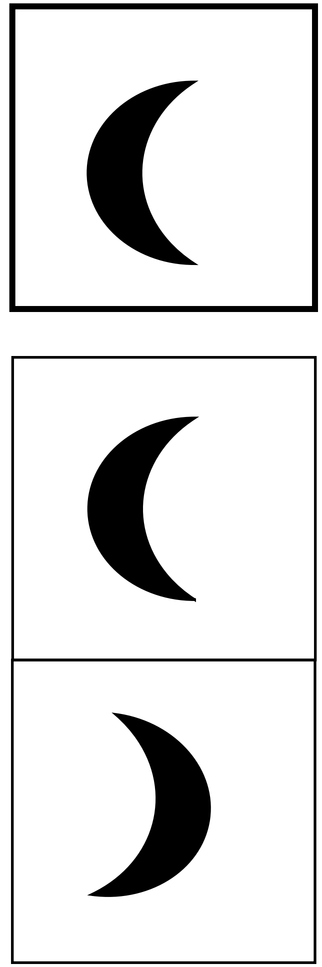

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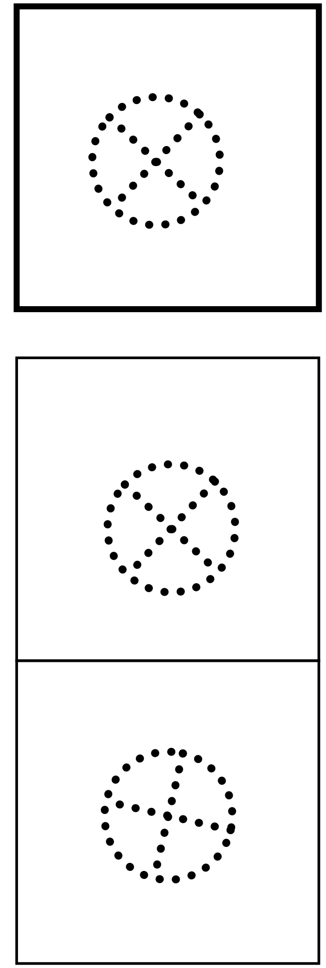

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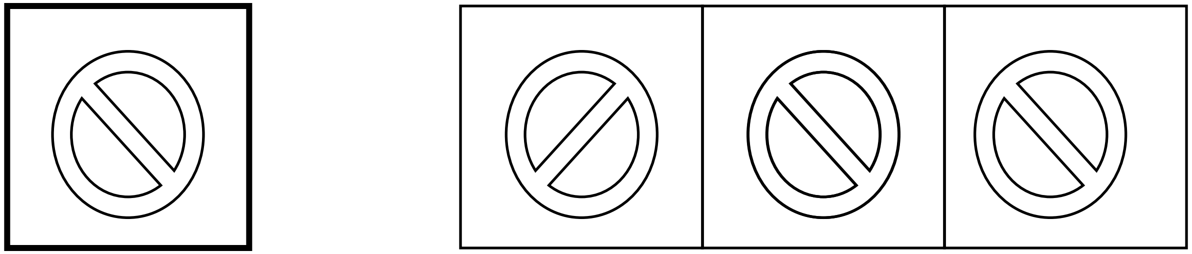

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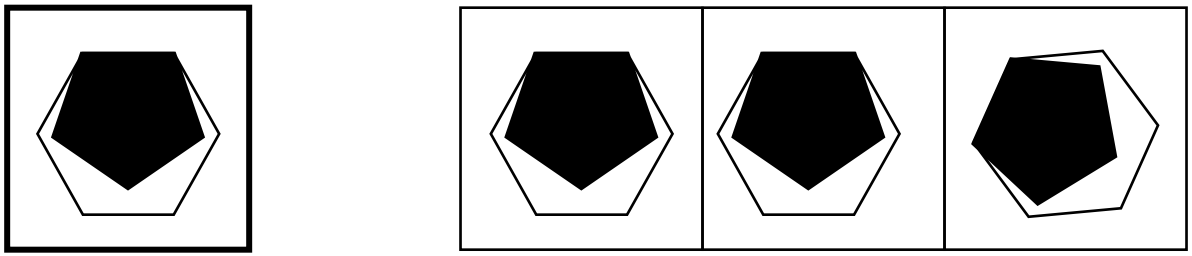

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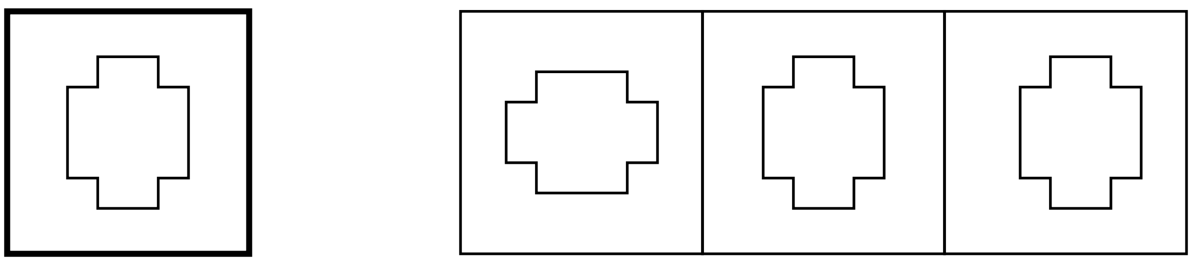

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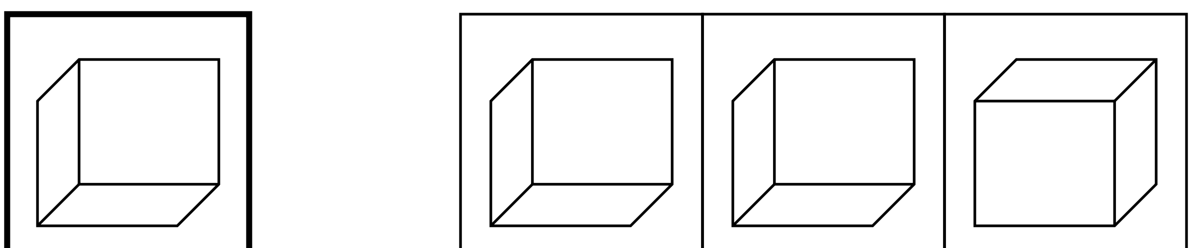

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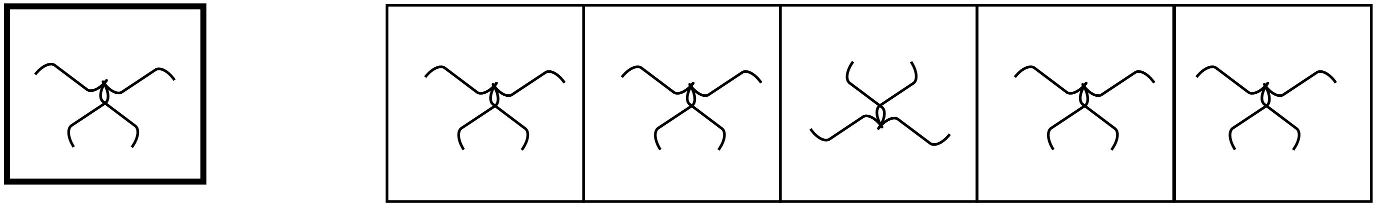
9 

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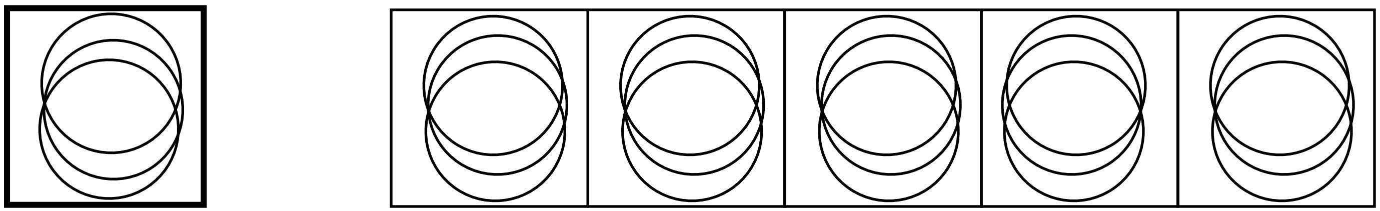
10 

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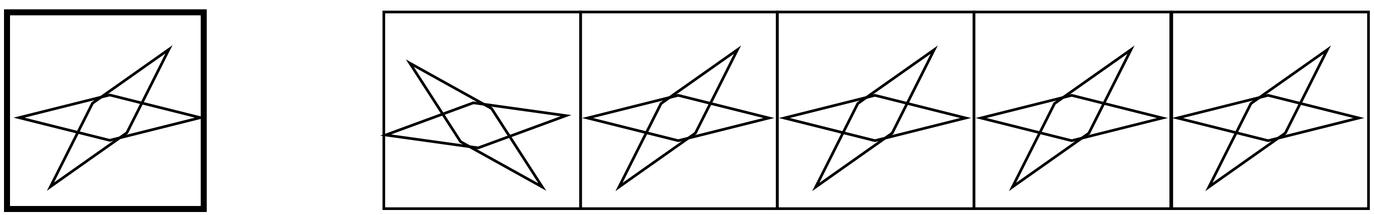
11 

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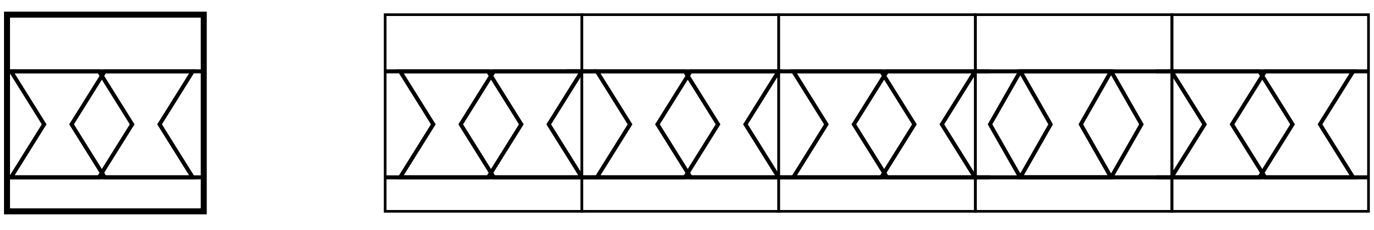
12 

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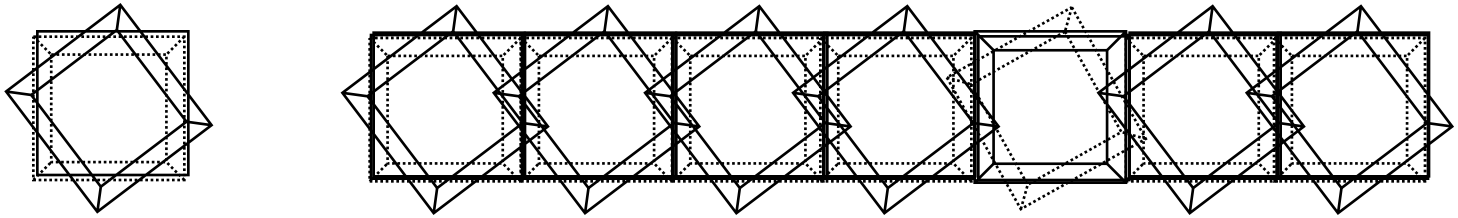
13 

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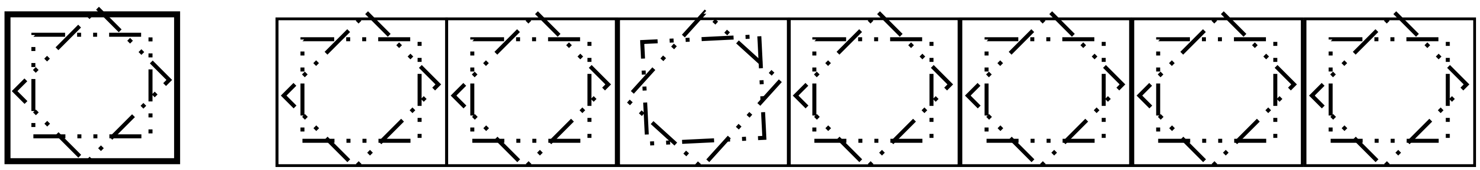
14 

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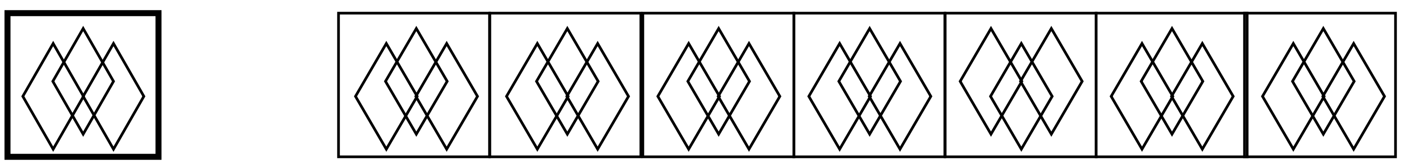
15 

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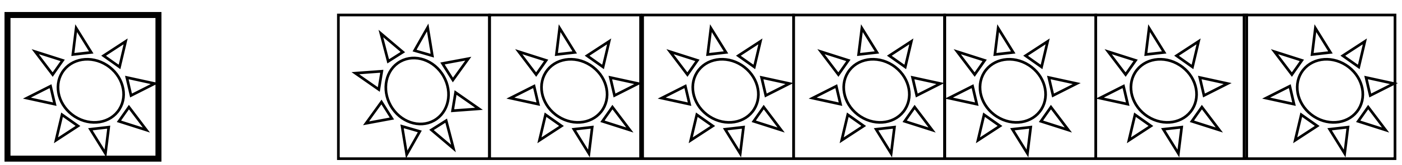
16 

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SUBTEST: POSITION-IN-SPACE (P-S) **<u>VISUAL SPATIAL PROCESSING ASPECTS</u>**

(*Similar Tests: SSAIS-R: pattern completion (subtest); Gardiner's TVPS: visual spatial relationship subtest*)

Task:	To locate a 2- or 3D view of a form which presents itself in the same directional position as the target form
Purpose:	To evaluate the learner's ability to be aware of the spatial orientation of objects, first to self then to other objects
Over and above:	Requires visual attention, visual scanning, laterality, reasoning and comprehension
Ceiling:	Three consecutive unsuccessful responses
Time Allocation:	2 to 9 seconds (taking into account the learner's age and the item's level of difficulty)
Material:	

- ✓ 3D Shapes: four rectangles
- ✓ Test Booklet containing 16 Position-in-Space Plates

Procedure:

❖ **Concrete Example: four plastic 3-dimensional rectangle shapes**

<u>Instructions</u>:

The tester places a row of rectangles in front of the learner in an array of different directional positions (i.e. –I –- I). Say to the learner, **"See these forms are the same shape…"** (whilst **pointing to a rectangle).** Then say, **"…but look how they can change the way that they point"** (whilst **pointing** to the remaining rectangles on the table and **remarking** on their directional position). **Which one is pointing in the same direction as you are?"**

❖ **Test Booklet: 16 P-S Plates – 2- or 3D represented views of black stimuli on blue paper**

<u>Instructions</u>:

Present the P-S Test booklet to the learner, placing it in front of the learner. Open P-S Plate 1 in front of the learner. Say to the learner, **"Here are the exact same forms, but only one is going in the same way…"** (whilst **pointing** to the responses then to the target block) **"… as the one in this target block, look and find the one which is going in a same direction."** If the learner identifies the correct response **continue** with the next plate of the VSR subtest **until the ceiling is reached**.

If the learner is unable to allocate the correct response, once more demonstrate the Concrete and Plate 1 Examples. Record this unsuccessful attempt on the score sheet (see score sheet example). The learner may require prompting to make a choice if more time than is considered reasonable is taken (see time allocation). Record all responses on the score sheet by either circling or crossing through the learner's elected response to later assist with a possible diagnostic evaluation.

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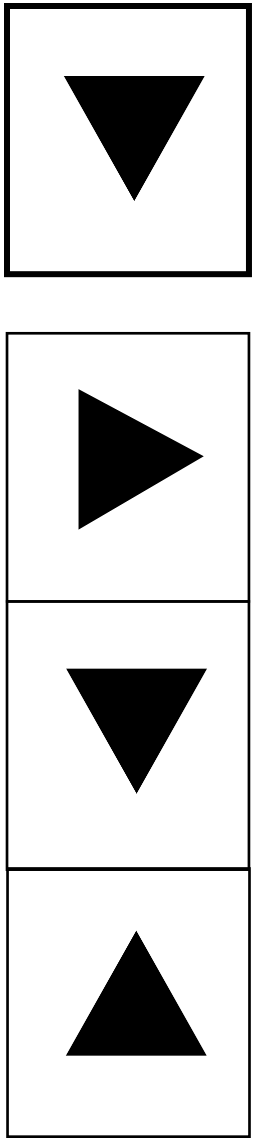

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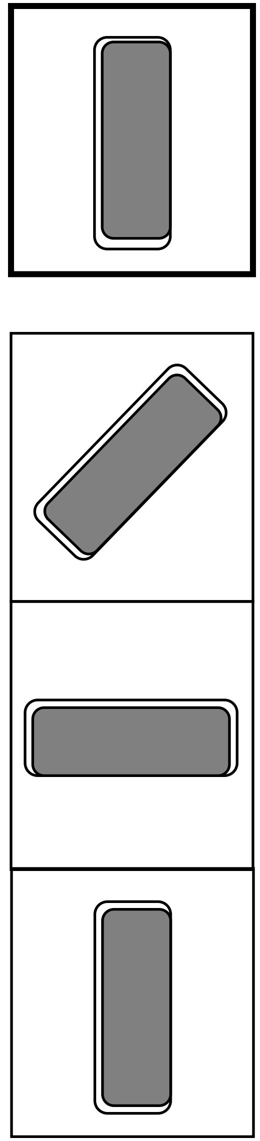

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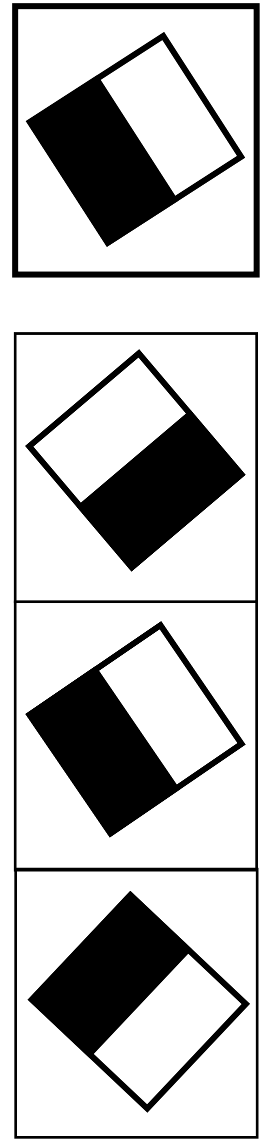

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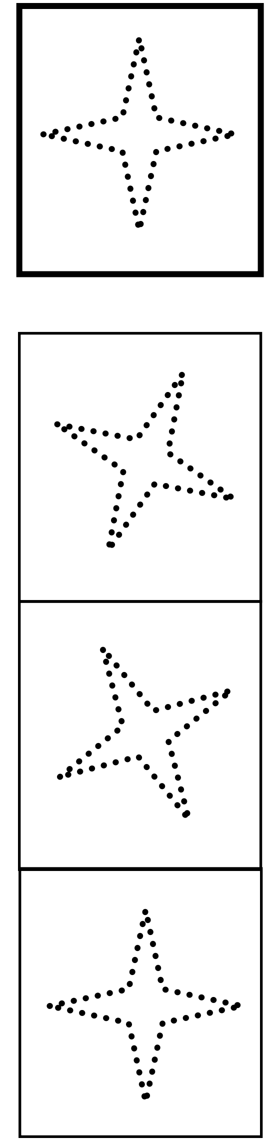

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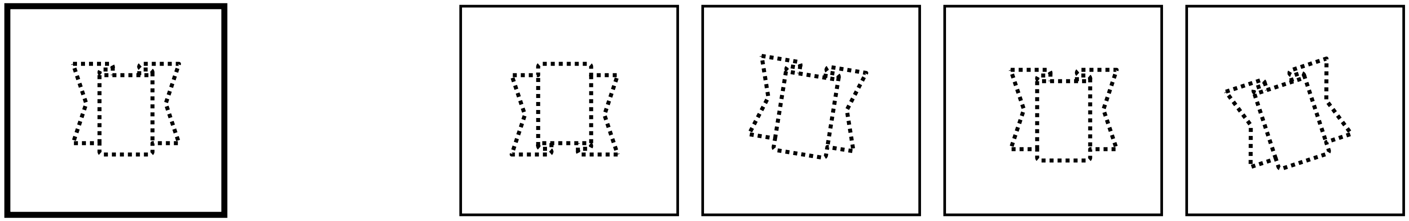
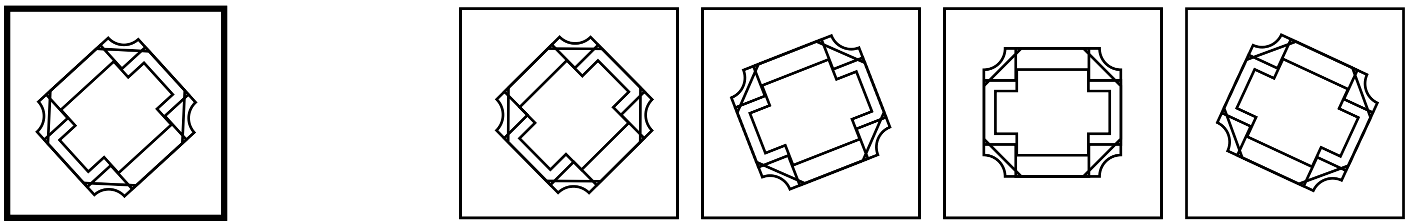
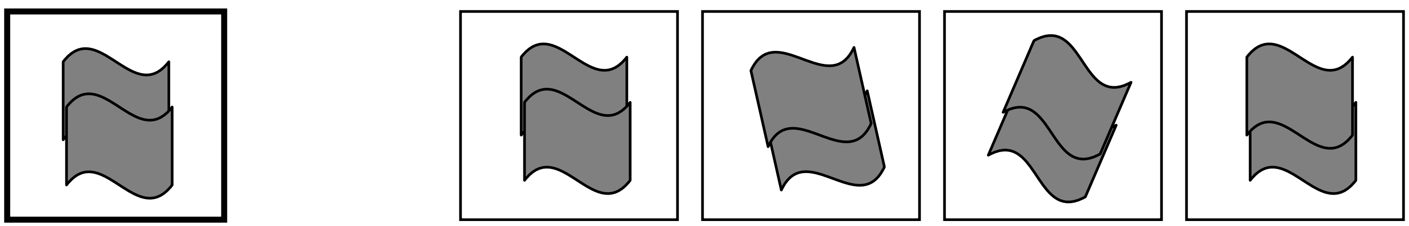
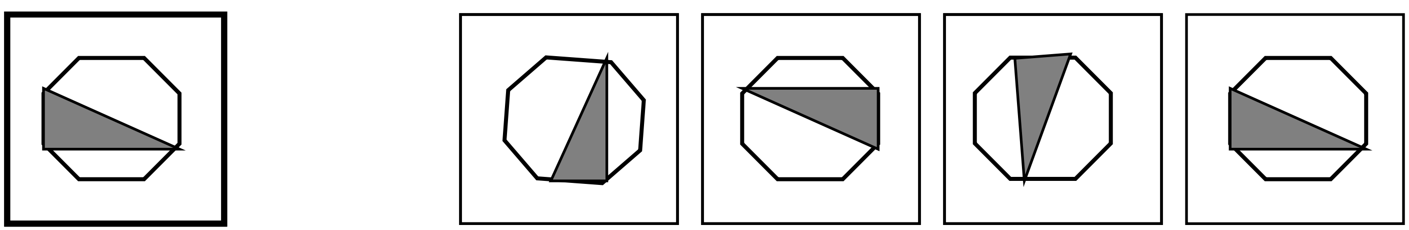
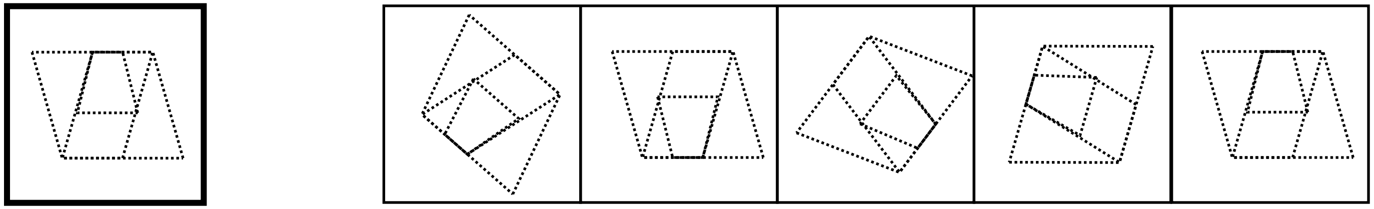
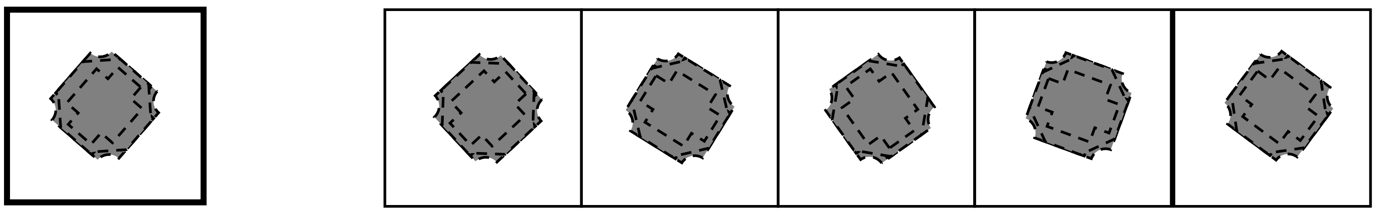
5  c 98

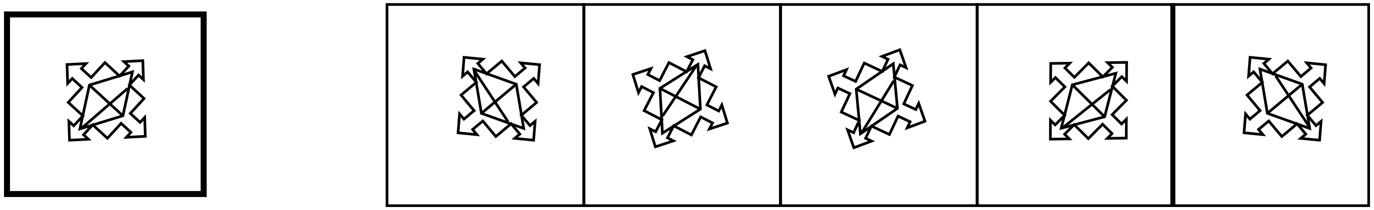
6  c 99

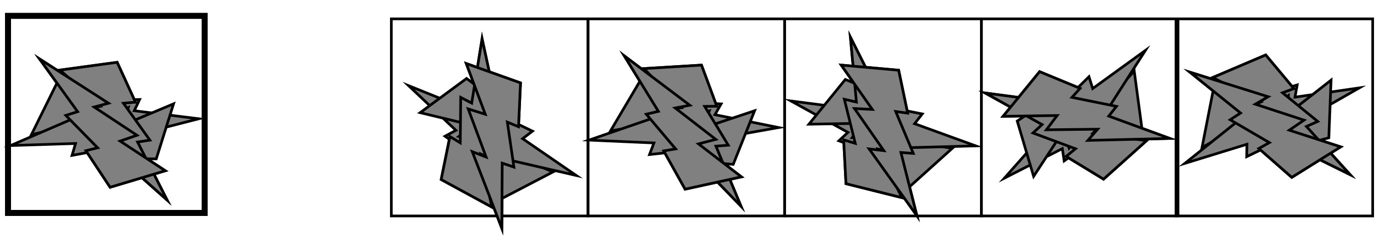
7  c 100

8  c 101

9  c 102

10  c 103

11  c 104

12  c 105

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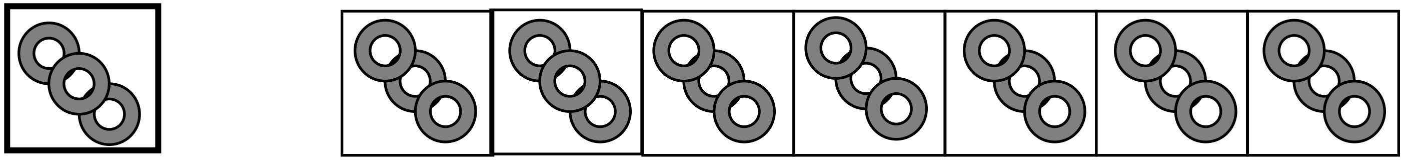

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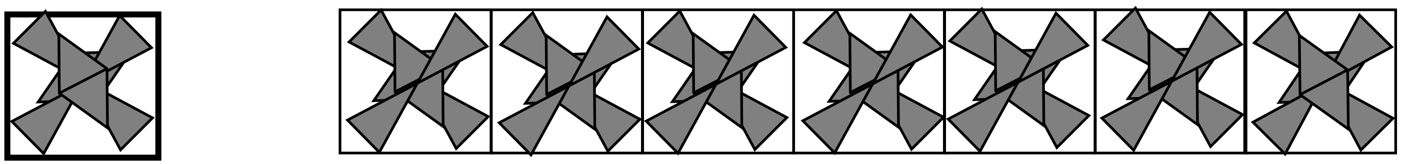

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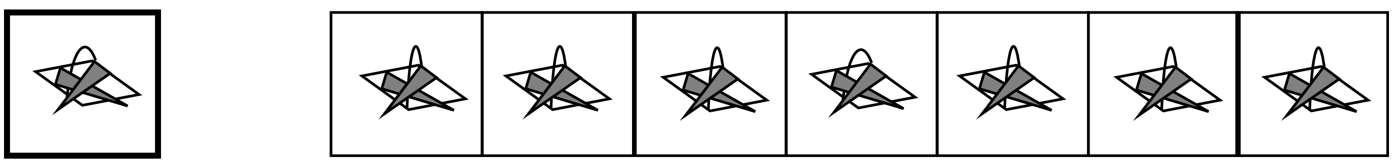

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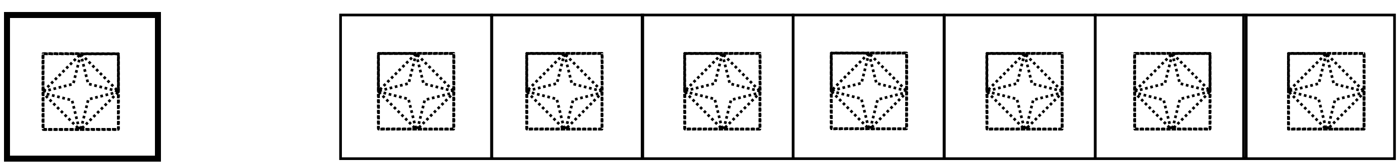

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SUBTEST: VISUAL FIGURE-GROUND (VF-G)

(*Similar Tests: Gardiner's TVPS- Subtest: Figure-Ground; DVPT - Figure-Ground - subtest 4*)

Task: To locate the same 2- or 3D form view even though it has been placed in a background

Purpose: To attend to a specific form whilst maintaining an awareness of the relationship of this form/feature to the background information

Over and above: Requires visual attention, visual scanning, reasoning and comprehending

Ceiling: Three consecutive unsuccessful attempts

Time allocation: 2 to 9 seconds (taking into account the learner's age and the item's level of difficulty)

Material:

- ✓ 3D Shapes: The entire array of shapes
- ✓ Test Booklet containing 16 Visual Figure-Ground Plates

Procedure:

❖ **Concrete Example: all plastic 3-dimensional shapes**

Instructions:

The tester places all the shapes on the table in front of the learner. Say to the learner, **"Can you find the blue star…"** (whilst **pointing to** the array of shapes on the table). Then say to the learner, **"…look and find it amongst these shapes".**

❖ **Test Booklet: 16 VF-G Plates - 2D black stimuli on blue paper**

Instructions:

Present the VF-G Test booklet to the learner, placing it in front of the learner. Open VF-G Plate 1 in front of the learner. Say to the learner, **"See this form in this block…"** (whilst **pointing to the target block** containing the single form). Then say to the learner, **"Look and find it amongst these forms."** (**pointing** now **to the blocks** containing the choices for the response). Once more emphasis to the learner the target form is hiding and close attention is required**) "Look very carefully … remember it is hiding and may have change its size, direction or colour".**

If the learner identifies the correct response continue with the next plate of the VF-G subtest until the ceiling is reached. If the learner is unable to allocate the correct response, once more demonstrate the Concrete and Plate 1 Examples. Record this unsuccessful attempt on the score sheet (see score sheet example). The learner may require prompting to make a choice if more time than is considered reasonable is taken (see time allocation). Record all responses on the score sheet by either circling or crossing through the learner's elected response to later assist with a possible diagnostic evaluation and to delineate the areas required for remediation.

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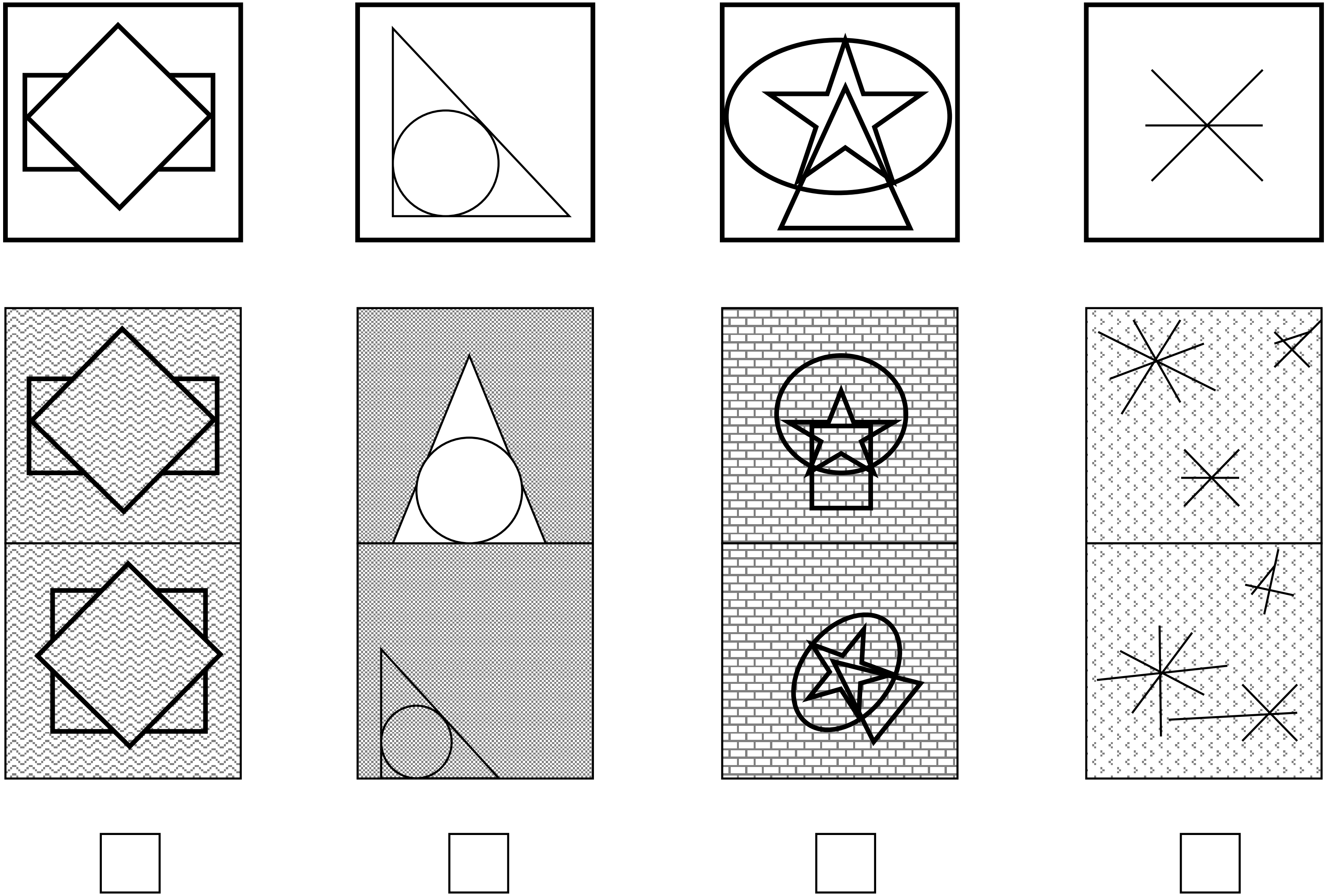

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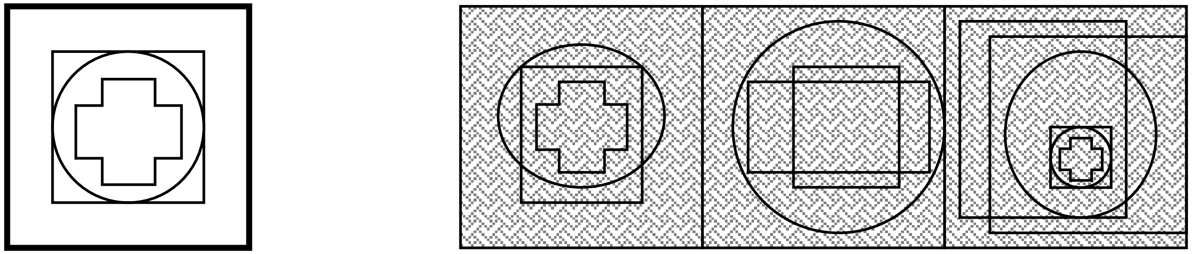
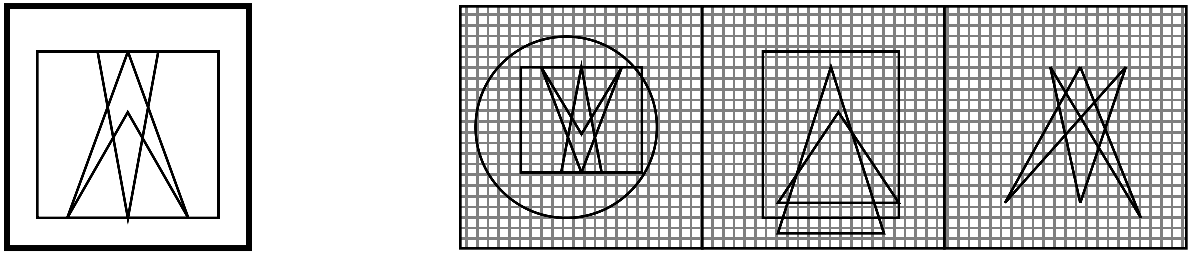
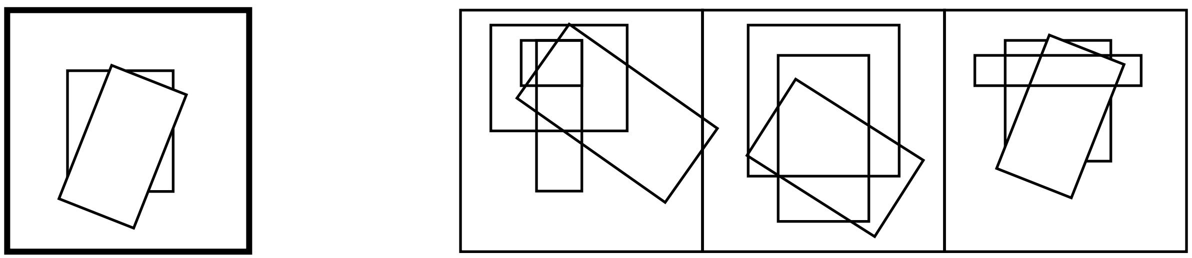
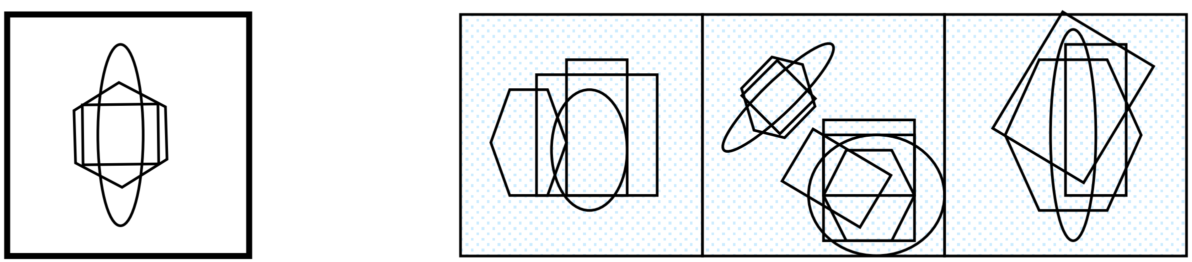
5  c 130

6  c 131

7  c 132

8  c 133

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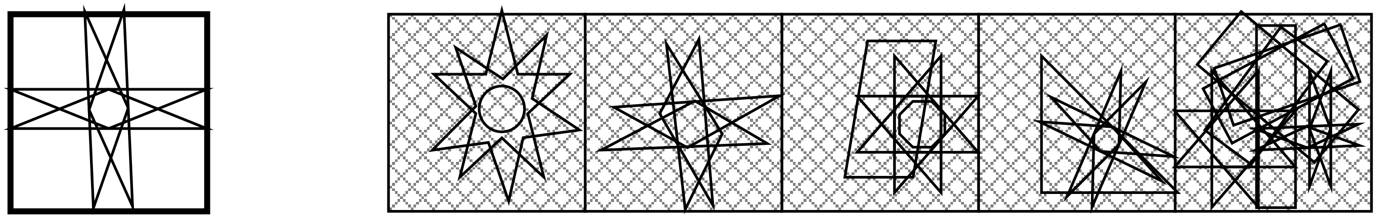

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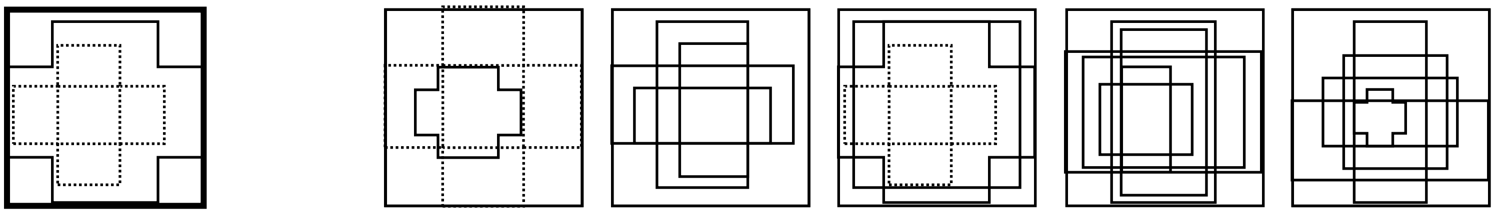

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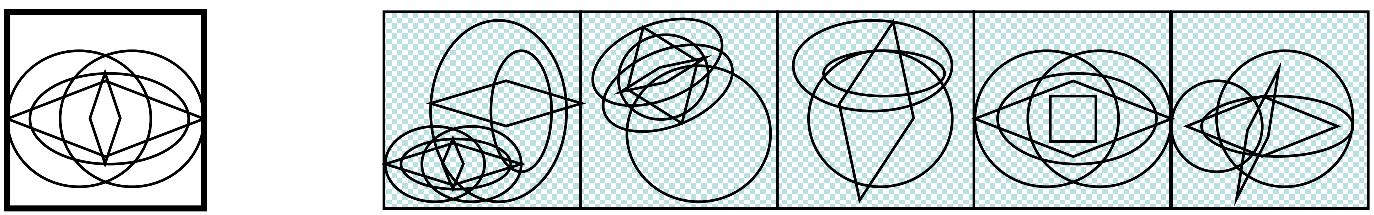

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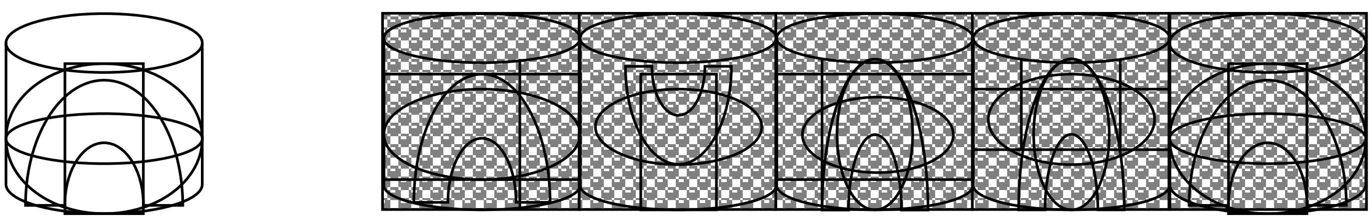

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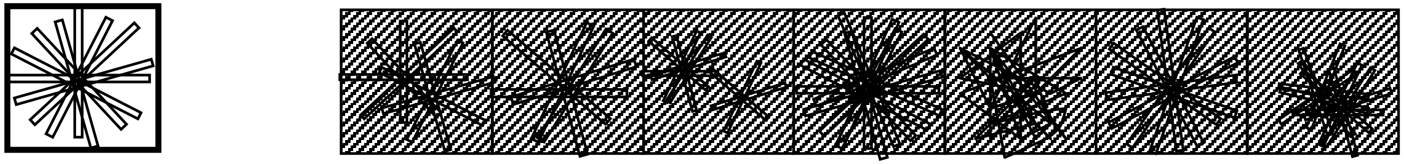

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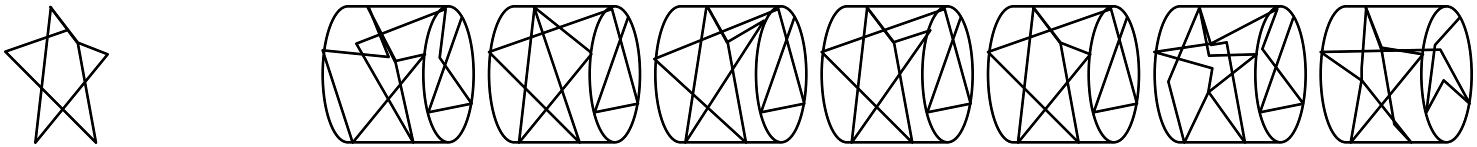

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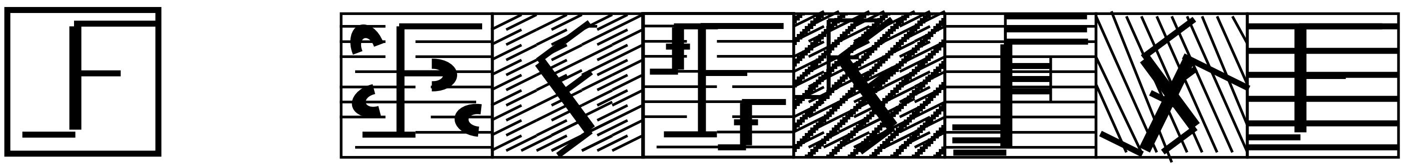

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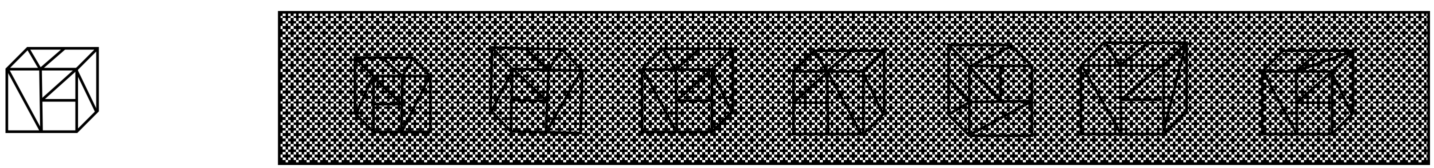

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SUBTEST: VISUAL CLOSURE (VC) **VISUAL PERCEPTUAL ANALYTICAL ASPECTS**

(*Similar Tests: SSAIS-R: pattern completion (items 1), Gardiner's TVPS - visual closure subtest; DVPT's visual closure: subtest 6; ITPA – Subtest: Visual Closure*)

Task:	To locate the identified form, even though it is incomplete in presentation.
Purpose:	To evaluate the learner's ability to identify and be aware of clues to a complete form from an incomplete visual representation.
Over and above:	Requires visual attention, visual memory, reasoning and comprehending
Ceiling:	Three consecutive unsuccessful attempts
Time allocation:	2 to 9 seconds (taking into account the learner's age and the item's level of difficulty)
Material:	

- ✓ A 3D Shape, pencil, paper and eraser
- ✓ Test Booklet containing 16 Visual Closure Plates

Procedure:

- ❖ **Concrete Example: a plastic 3-dimensional shape, pencil, paper and an eraser.**

Instructions:

The tester places the shape on a piece of paper and traces the outline onto the paper. Say to the learner, **"See this shape…"** (whilst **pointing to the shape).** Then say to the learner, **"…look if I erase a piece here, here and here can you still tell what the shape is"** (using the eraser erase pieces of the shape forming an incomplete shape).

- ❖ **Test Booklet: 16 VC Plates - 2D black stimuli on blue paper**

Instructions:

Present the VC Test booklet to the learner, placing it in front of the learner. Open VC Pate 1 in front of the learner. Say to the learner, **"See this form in this block…"** (whilst **pointing to the target block** containing the single form). Then say to the learner, **"… look at these forms…"** (**pointing** now **to the blocks below** containing the choices for the response). **"… which is the same form that is incomplete?"** If the learner identifies the correct response **continue** with the next plate of the VC subtest **until the ceiling is reached**.

If the learner is unable to allocate the correct response, once more demonstrate the Concrete and Plate 1 Examples. Record this unsuccessful attempt on the score sheet. The learner may require prompting to make a choice if more time than is considered reasonable is taken (see time allocation). Record all responses on the score sheet by either circling or crossing through the learner's elected response to later assist with a possible diagnostic evaluation and to delineate the areas required for remediation.

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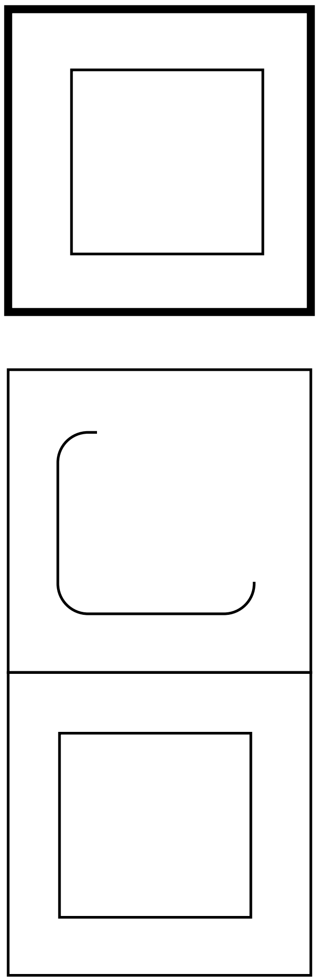

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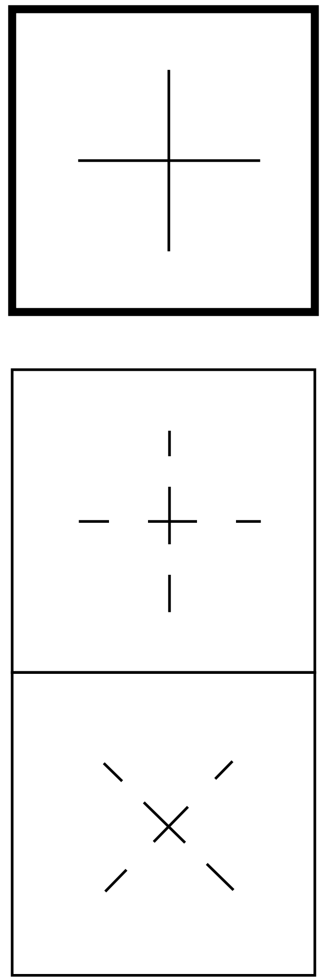

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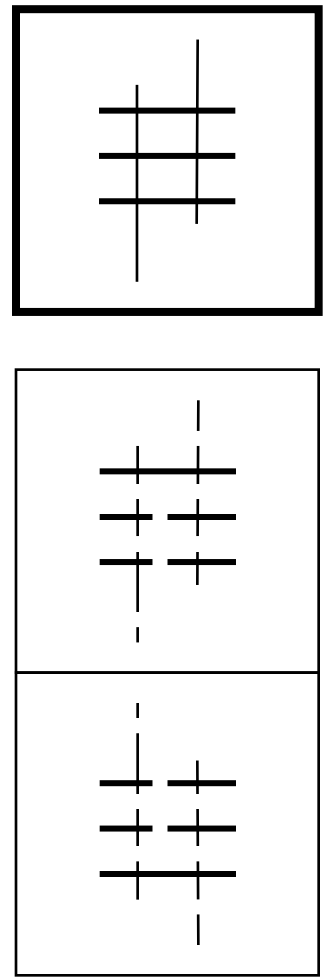

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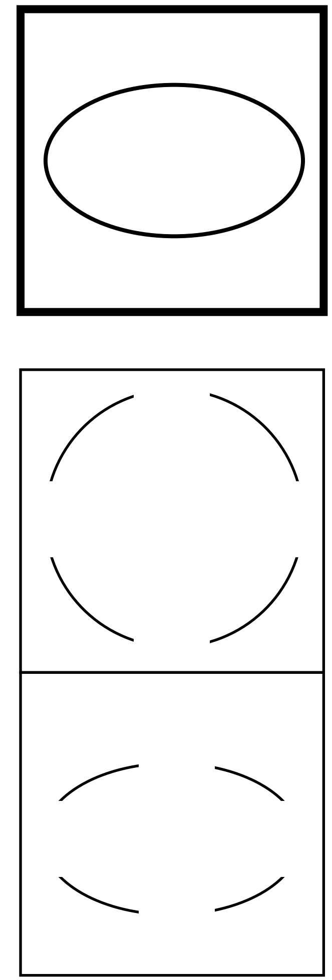

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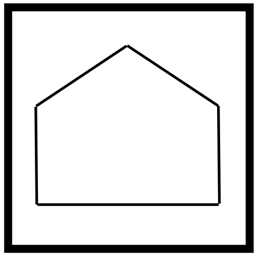
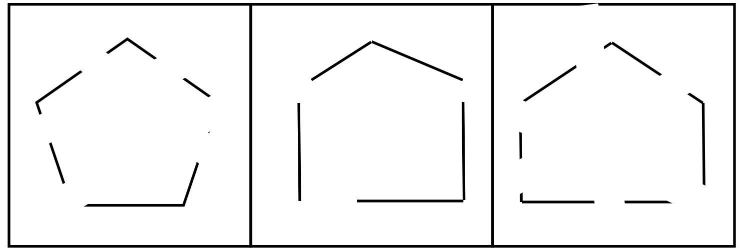
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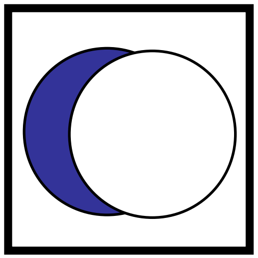
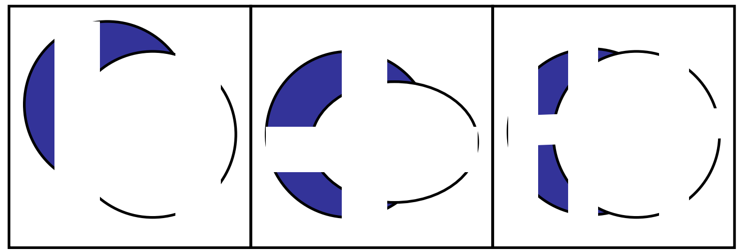
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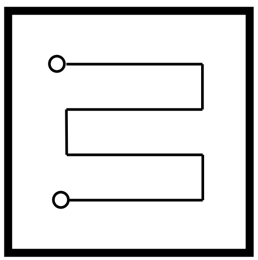
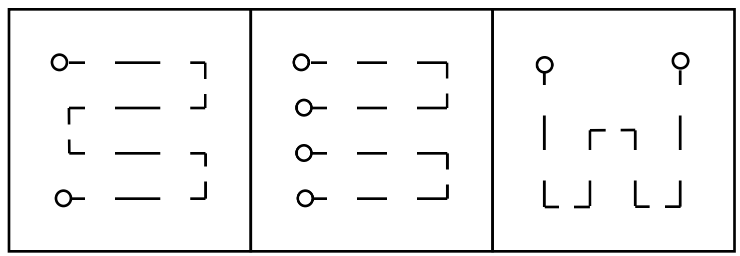
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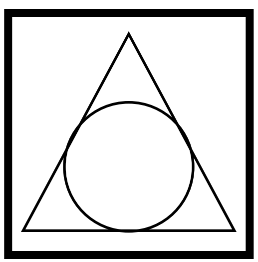
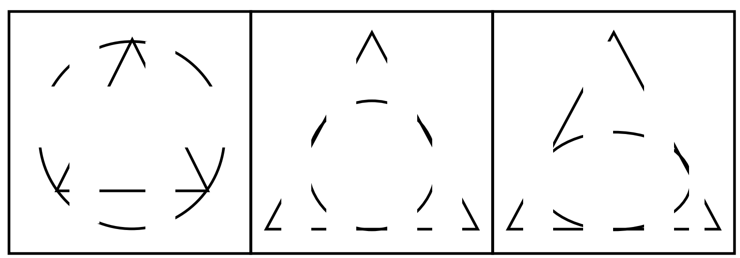
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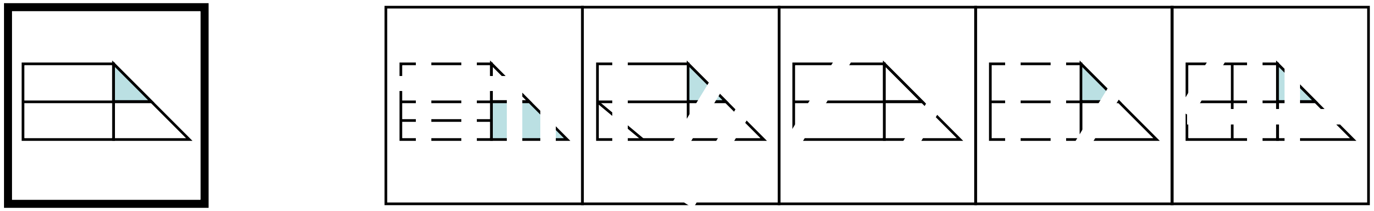

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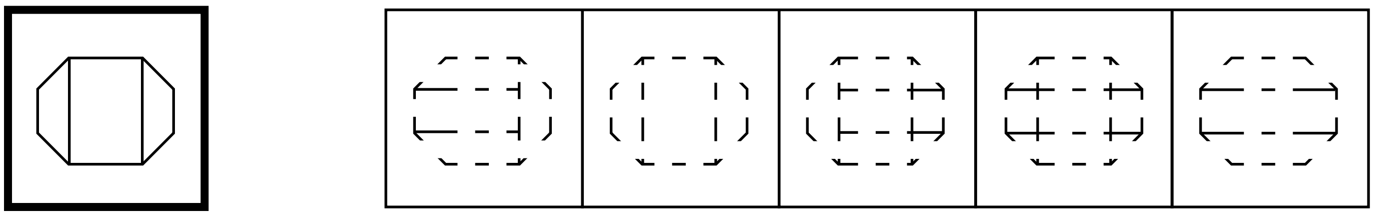

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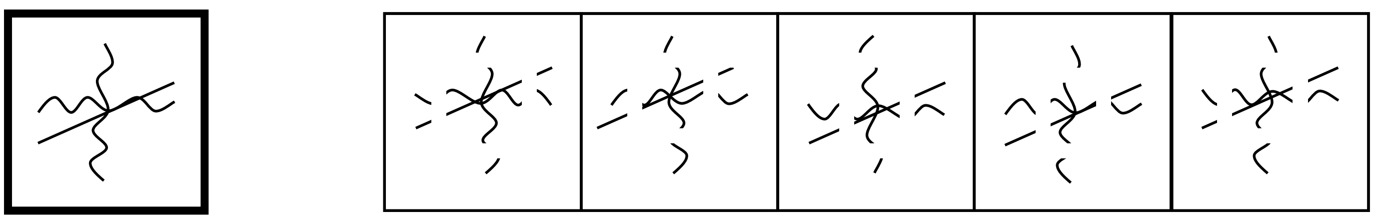

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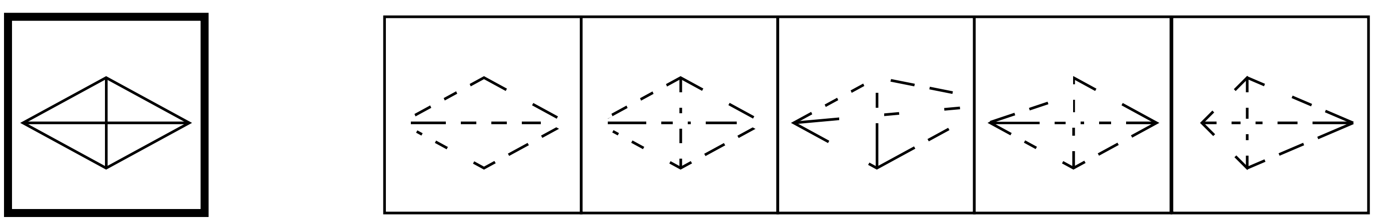

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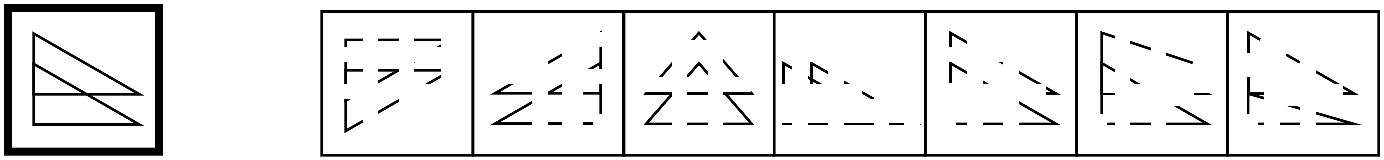
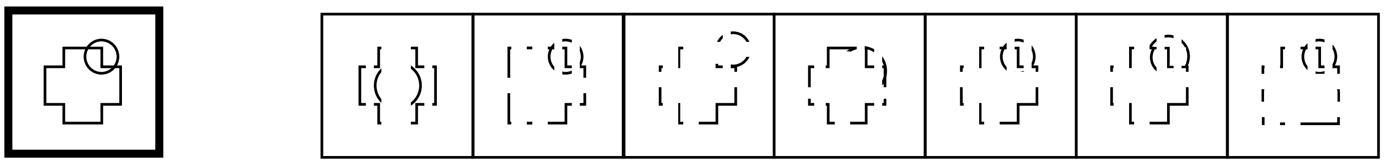
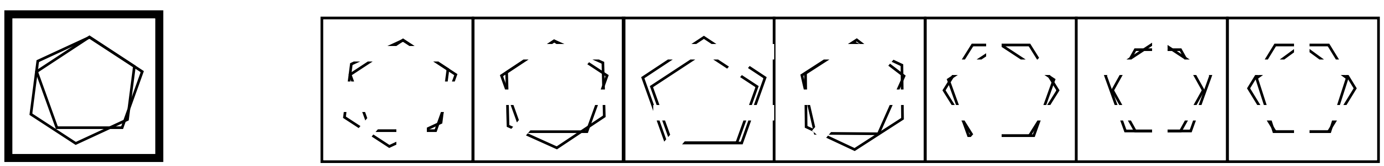
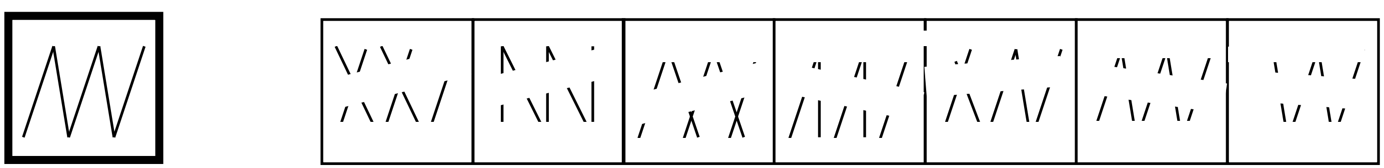
13  c 122

14  c 123

15  c 124

16  c 125

(*Similar Test: JSAIS & SSAIS-R : Block design and Form Board Subtests*)

Task:	To analyse (break up) a represented form or to assemble a form view presented
Purpose:	To evaluate the learner's capacity to analyse, as well as to assemble 2- or 3D form views presented on paper
Over and above:	Requires visual attention, visual scanning, reasoning, comprehending and planning
Ceiling:	Three consecutive unsuccessful attempts
Time allocation:	2 to 9 seconds (taking into account the learner's age and the item's level of difficulty)
Material:	

- ✓ 3D Shapes: diamond and two triangles
- ✓ Test Booklet containing 16 Visual Form Constancy Plates

Procedure:

❖ **Concrete Example: plastic 3-dimensional shapes (a diamond and two triangles)**

Instructions:

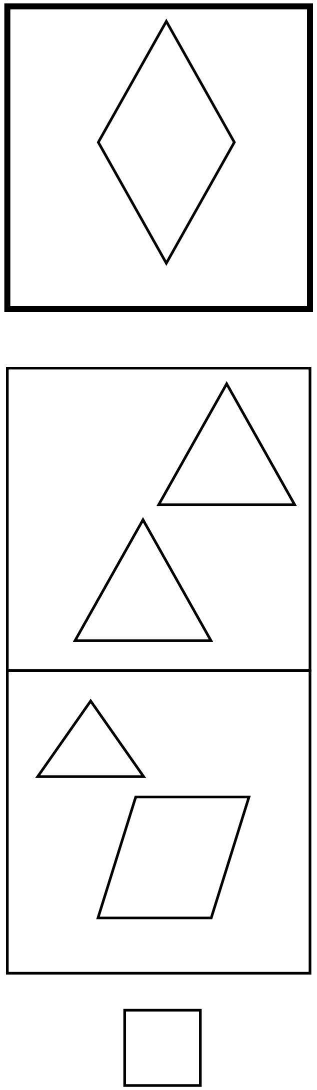
The tester places the diamond in front of the learner. Say to the learner, **"See this shape…"** (whilst **pointing to the diamond).** Then say to the learner, **"…can these shapes be used to build it… or these"** (whilst **pointing to the remaining shapes** [two triangles] on the table**).**

❖ **Test Booklet: 16 VA/S Plates - 2D black stimuli on blue paper**

Instructions:

Present the VA/S Test booklet to the learner, placing it in front of the learner. Open VA/S Plate 1 in front of the learner. Say to the learner, **"See this form in this block…"** (whilst **pointing to the target block** containing the single form). Then say to the learner, **"what can be used to build it?"** (**pointing** now **to the blocks below** containing the choices for the response). If the learner identifies the correct response **continue** with the next plate. Open VA/S Plate 2 in front of the learner. Say to the learner, **"See these shapes what can you build with it…"** (whilst **pointing to the target block** containing the single form). Then say to the learner, **"what can be used to build it?"** (**pointing** now **to the blocks below** containing the choices for the response). If the learner identifies the correct response **continue** with the next plate of the VA/S subtest **until the ceiling is reached**. If the learner is unable to allocate the correct response, once more demonstrate the concrete and Plate 1 xamples. Record this unsuccessful attempt on the score sheet (see score sheet example). The learner may require prompting to make a choice if more time than is considered reasonable is taken (see time allocation). Record all responses on the score sheet by either circling or crossing through the learner's elected response to later assist with a possible diagnostic evaluation and to delineate the areas required for remediation.

1



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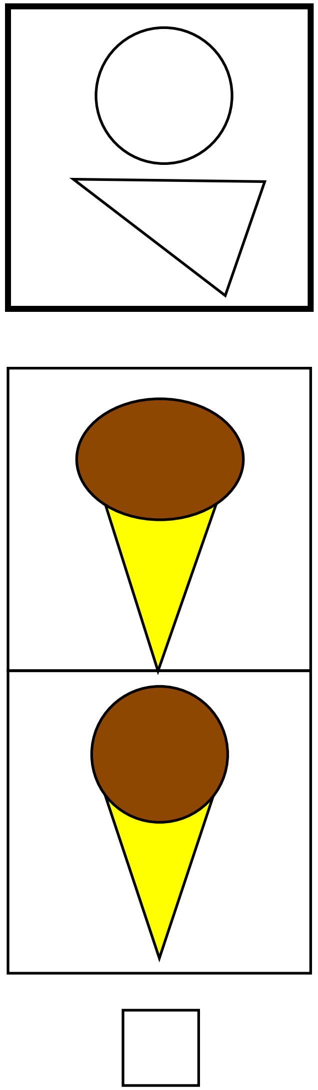

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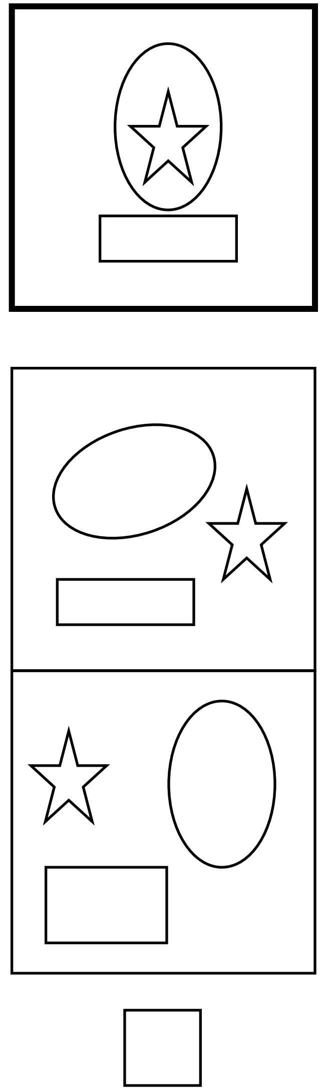

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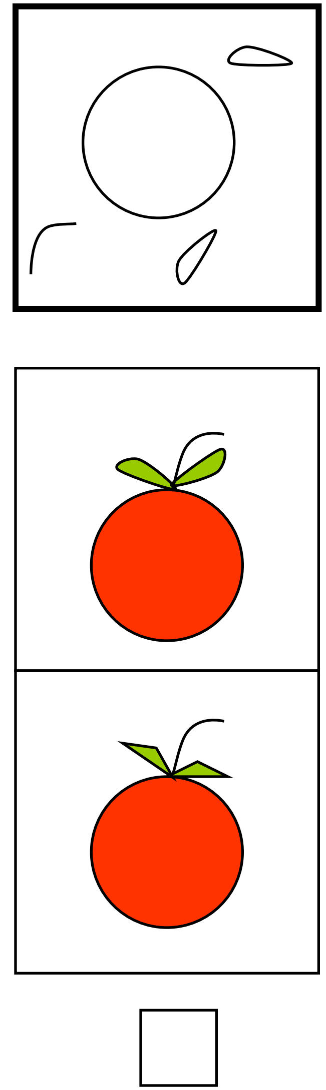

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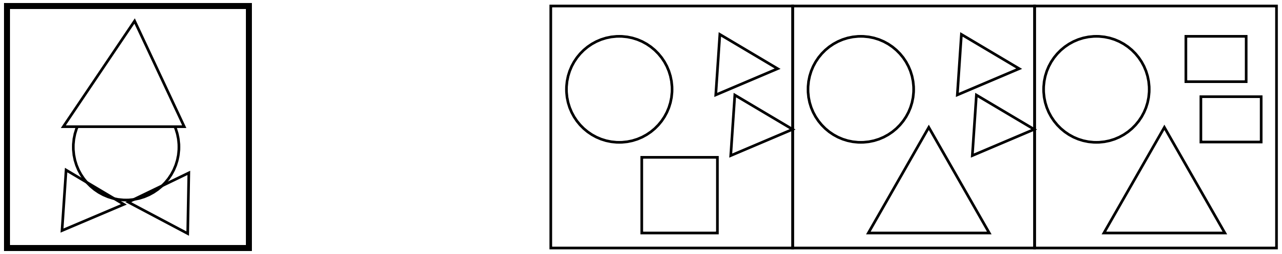

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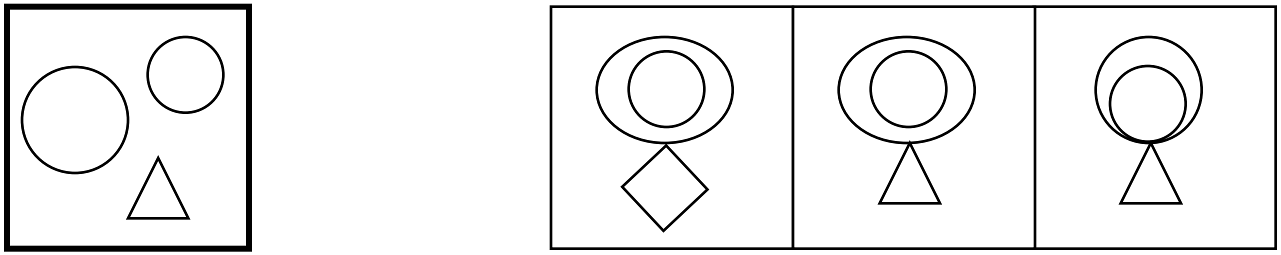

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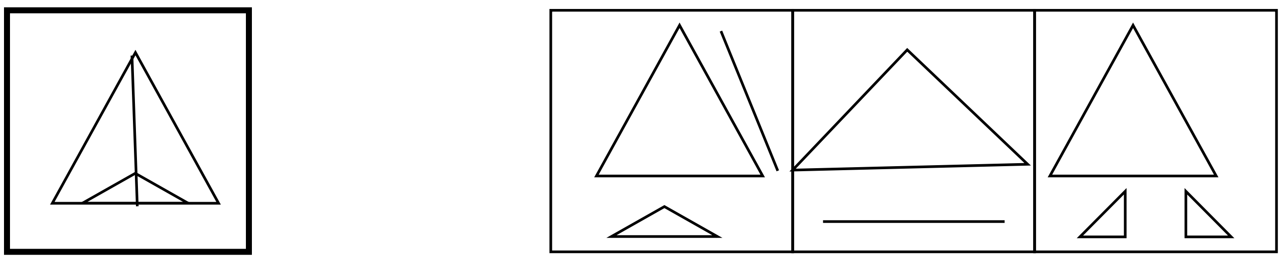

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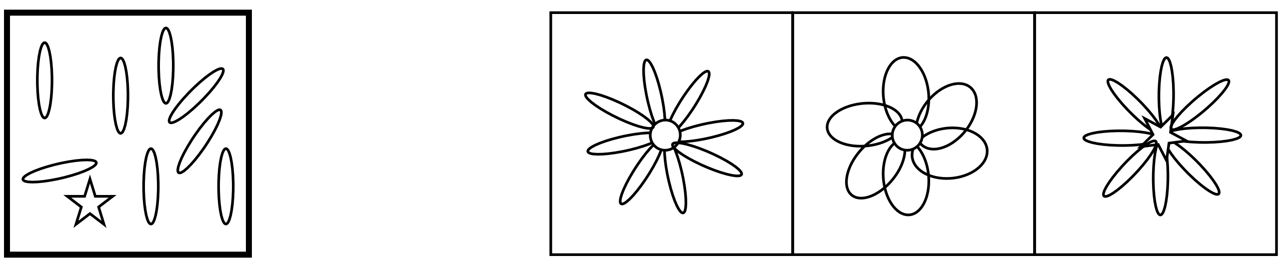

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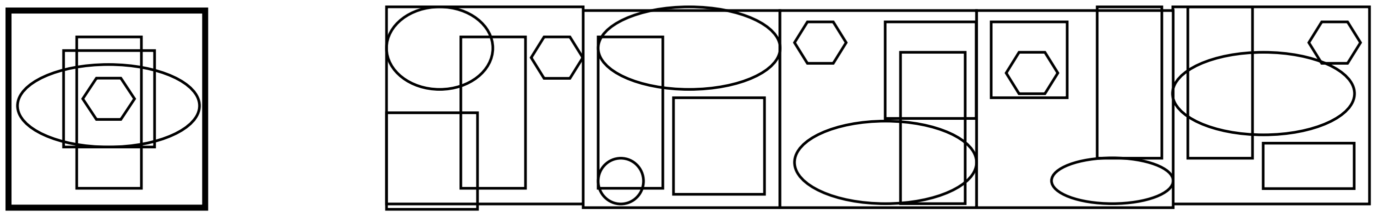

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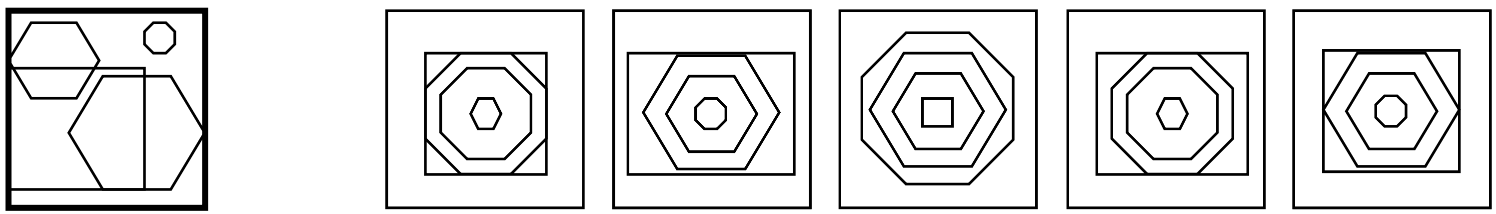

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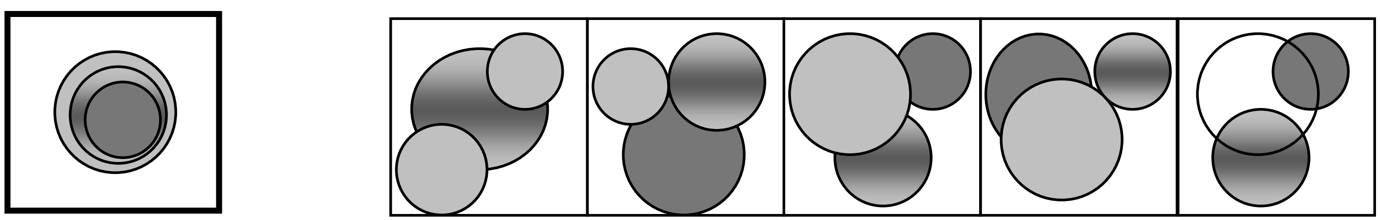

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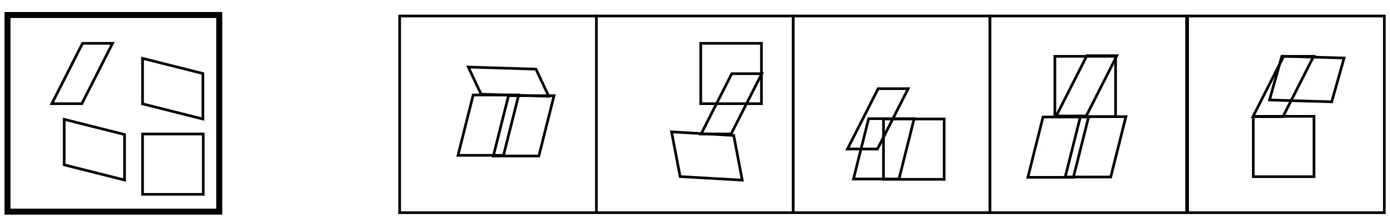

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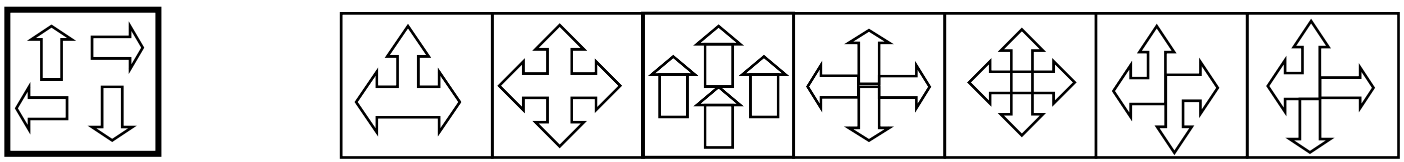
14 

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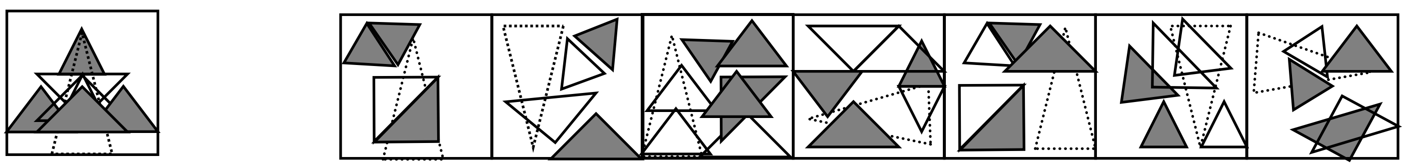
15 

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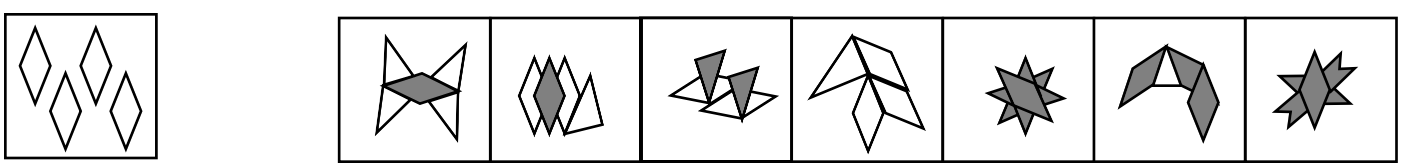
16 

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APPENDIX F

VISUAL PERCEPTUAL ASPECTS TEST (VPAT)

(Reduced Motor Component)

University of South Africa

Sylvia Clutten

PROFILE AND SCORE SHEET

Reason for Referral: ____

General Observation: (underline)

Body Posture		normal	weak	
Follows instructions	well	successfully	unsuccessfully	
Completion speed	fast	normal	slow	
Hand Dominance	right	undefined	left	
Bilateral hand usage		yes	single	
Attention span	low	normal	high	

Overall Assessment Behaviour:

shy	talkative	spontaneous	withdrawn
reserved	confident	passive	active
restless	aggressive	anxious	inquisitive

Profile Chart

Stanine	VD	VFC	VM	VSM	VSR	P-S	VC	VA/S	VF-G	Stanine
1	.	.	.	.	.	.	.	.	.	1
2	.	.	.	.	.	.	.	.	.	2
3	.	.	.	.	.	.	.	.	.	3
4	.	.	.	.	.	.	.	.	.	4
5	.	.	.	.	.	.	.	.	.	5
6	.	.	.	.	.	.	.	.	.	6
7	.	.	.	.	.	.	.	.	.	7
8	.	.	.	.	.	.	.	.	.	8
9	.	.	.	.	.	.	.	.	.	9

IDENTIFYING INFORMATION

Name: ____ Sex: F M

School: ____

Grade: R 1 2 3 Test Administrator: ______________________________

Date of Assessment: ________ year ________ month ________ day

Date of Birth: ________ year ________ month ________ day

Chronological Age: ________ years ________ months

ASSESSMENT RESULTS OF VPAT

	Raw Scores	Stanine
Visual Discriminatory Aspects		
Visual Discrimination (VD)	_______	_______
Visual Form Constancy (VFC)	_______	_______
Visual Memory Aspects		
Visual Memory (VM)	_______	_______
Visual Sequential Memory (VSM)	_______	_______
Visual Spatial Processing Aspects		
Visual Spatial Relationships (VSR)	_______	_______
Position-in-Space (P-S)	_______	_______
Visual Perceptual Analysis Aspects		
Visual Closure (VC)	_______	_______
Visual Figure-Ground (VF-G)	_______	_______
Visual Analysis and Synthesis (VA/S)	_______	_______

VISUAL PERCEPTUAL ASPECTS TEST (VPAT)

VISUAL DISCRIMINATORY ASPECTS		VISUAL MEMORY ASPECTS		VISUAL SPATIAL PROCESSING ASPECTS		VISUAL ANALYSIS ASPECTS		
Visual Discrimination	**Visual Form Constancy**	**Visual Memory**	**Visual Sequential Memory**	**Visual Spatial Relationships**	**Position-in-Space**	**Visual Figure-Ground**	**Visual Closure**	**Visual Analysis and Synthesis**
1. **A** B	1. **A** B	1. **A** B	1. A **B**	1. A **B**	1. A **B** C	1. A **B**	1. A **B**	1. **A** B
2. **A** B	2. A **B**	2. A **B**	2. **A** B	2. **A** B	2. A B **C**	2. A **B**	2. **A** B	2. A **B**
3. A **B**	3. A **B**	3. A B **C**	3. A **B** C	3. A **B**	3. A **B** C	3. A **B**	3. **A** B	3. **A** B
4. A **B**	4. A **B**	4. A **B** C	4. A B **C**	4. A **B**	4. A B **C**	4. **A** B	4. A **B**	4. **A** B
5. A B **C**	5. A B **C**	5. A **B** C D	5. **A** B C	5. **A** B C	5. A B **C** D	5. A B **C**	5. A B **C**	5. A **B** C
6. A B **C**	6. A **B** C	6. A B **C** D	6. A B **C** D	6. A B **C**	6. **A** B C D	6. **A** B C	6. A B **C**	6. A B **C**
7. A **B** C	7. A **B** C	7. A B C **D**	7. **A** B C D	7. **A** B C	7. **A** B C D	7. A B **C**	7. **A** B C	7. **A** B C
8. A B **C**	8. A B **C**	8. A **B** C D	8. A **B** C D	8. A B **C**	8. A B C **D**	8. A **B** C	8. A **B** C	8. A B **C**
9. A B **C** D E	9. A B **C** D E	9. A B **C** D E	9. A B C **D**	9. A B **C** D E	9. A B C D **E**	9. A B C **D** E	9. A B C **D** E	9. A B **C** D E
10. A B C D **E**	10 **A** B C D E	10. A B C D **E**	10. A B C **D**	10. A B C **D** E	10. **A** B C D E	10. A B **C** D E	10. A **B** C D E	10. A B C D **E**
11. A B C **D** E	11 A B C **D** E	11. A B C **D** E	11. **A** B C D	11. **A** B C D E	11. A B C **D** E	11. **A** B C D E	11. A B C **D** E	11. A B C **D** E
12. A **B** C D E	12 A **B** C D E	12. A B C D E **F**	12. A B C **D**	12. A B C **D** E	12. A **B** C D E	12. A B C D **E**	12. A **B** C D E	12. A B **C** D E F G
13. A B C D **E** F G	13 **A** B C D E F G	13. A B C D **E** F	13. A B C **D**	13. A B C D **E** F G	13. A **B** C D E F G	13. A B C D E **F** G	13. A B C D **E** F G	13. A B C **D** E F G
14. A B C D E F **G**	14 A B C **D** E F G	14. A B **C** D E F	14. A B **C** D	14. A B **C** D E F G	14. A B C D E F **G**	14. A B C D **E** F G	14. A B C D **E** F G	14. A B C **D** E F G
15. A B **C** D E F G	15 A B C D **E** F G	15. A **B** C D E F	15. A B C **D**	15. A B C D **E** F G	15. A B C **D** E F G	15. A B C D E F **G**	15. **A** B C D E F G	15. A B **C** D E F G
16. A B C **D** E F G	16 A **B** C D E F G	16. A B **C** D E F	16. A **B** C D	16. **A** B C D E F G	16. A B C D **E** F G	16. A B **C** D E F G	16. A B C D E **F** G	16. A B C D **E** F G
VD = ___________	**VFC =** __________	**VM =** ___________	**VSM =** __________	**VSR =** __________	**P-S =** ___________	**VF-G =** __________	**VC =** ___________	**VA/S =** _________

(**RAW SCORES:** sum all correct responses in each subtest column to obtain the raw score for each subtest. Transfer to "Assessment Results" on the face sheet of this portocol.)

Visual Information Processing Assessment Behavioural Performance Observations

	Observable Performance Behaviour		(Adapted from Scheiman and Gallaway, 2006:376)	
Performance style and overall approach to task	reflective impulsive	gives up easily perseveration	short attention span performs slowly	
Visual attention	answers before question is asked squirms in seat or fidgets fails to pay close attention to details		appears driven or "on the go" easily distracted by extraneous stimuli forgetful	
	motor flow	no support from nondominant hand		
Visual cognitive aspects	difficulty in understanding instructions short attention span concentration difficulty hyperactive		fear of failure withdrawn hypoactive	traces or touches forms subvocalisation

Task One

Categorisation	colours	shapes	
Object recognition	can name	not assigned meaning as yet	
Approach	confident engages	hesitant refusal	unsure
Hand Dominance	right	unestablished	left
Bilateral hand usage	yes	hesitant	single
Performance Speed	fast	average	slow

SUBTEST: VISUAL MEMORY (VM)

(*Similar Test: Gardiner's TVPS – Subtest: Visual Memory*)

Task: To identify and hold a 2- or 3 D represented form view in the working memory

Purpose: To evaluate the learner's ability to remember and to recognise and recall a visually presented 2- or 3D form view

Over and above: requires visual attention, visual scanning, reasoning and comprehending

Ceiling: Three consecutive unsuccessful responses

Time Allocation: 8 seconds for younger learners and 4 to 5 seconds for older learners

Material:

- ✓ 3D plastic shapes: the same coloured square and triangle shapes
- ✓ Test Booklet containing 32 Visual Memory Plates

Procedure:

❖ **Concrete Example: plastic 3-dimensional shapes (triangle and square)**

Instructions:

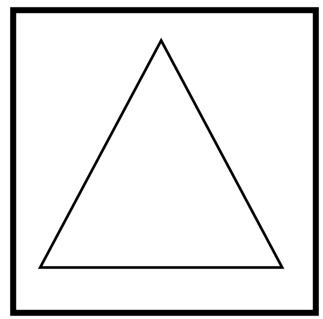
The tester places the triangle on the table in front of the learner. Say to the learner, **"See this shape… look carefully you must remember it so that you can find it again…"** (whilst **pointing to the shape).** Allow the learner time to view the shape (see time allocation) before removing it. Then say, **"…which shape did I show you"** (whilst **placing both shapes** [square and triangle] on the table in front of the learner).

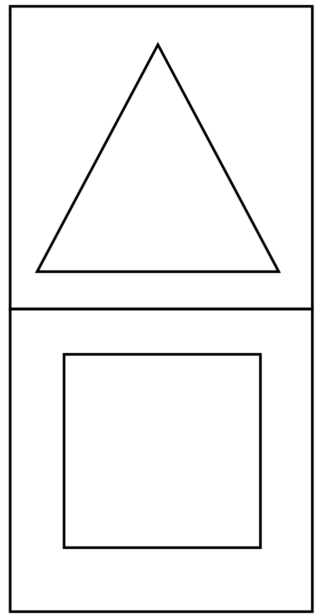
❖ **Test Booklet: 32 VM Plates - 2D black stimuli on blue paper**

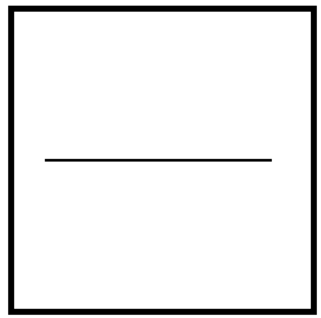
Instructions:

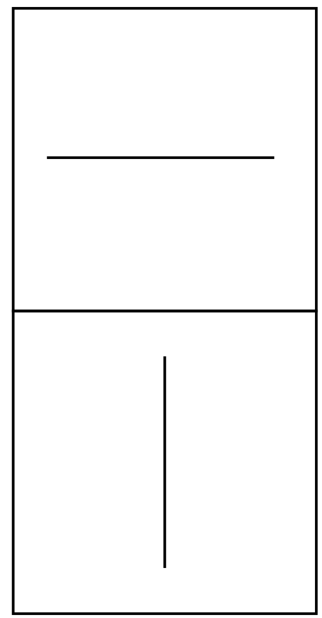
Place the VM Test booklet in front of the learner. Open VM Plate 1 in front of the learner. Say to the learner, **"See this form… look carefully as you must remember it so that you can find it on the next page…"** (whilst **pointing to the single target form** on the plate). After you have returned the page say, **"… look and find it between these forms"** (whilst **pointing to the choice of response items** on the plate). Allocated time for the learner to view the design (see time allocation above). If the learner identifies and nominates the correct response **continue** with the next plate of the VM subtest **until the ceiling is reached**.

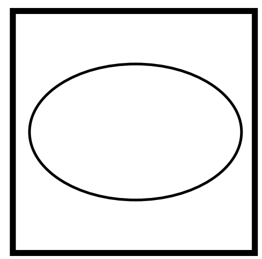
If the learner is unable to allocate the correct response, once more demonstrate the Concrete and Plate 1 Examples. Record this unsuccessful attempt on the score sheet (see score sheet example). The learner may require prompting to make a choice if more time than is considered reasonable is taken (see time allocation). Remember a majority of learners will can require allocated time, then proceed at the pace set by the individual learner. Record all responses on the score sheet by either circling or crossing through the learner's elected response to later assist with a possible diagnostic evaluation.

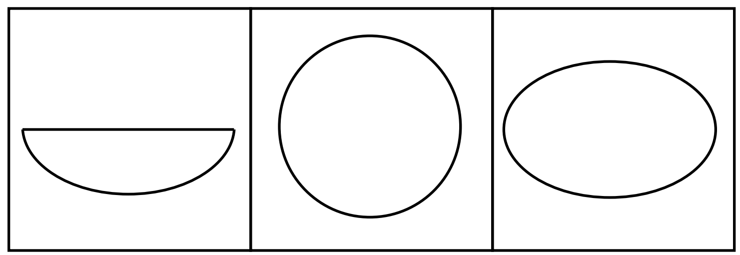


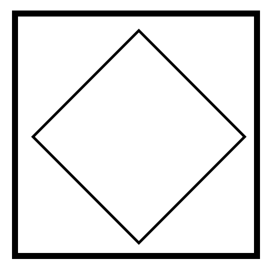


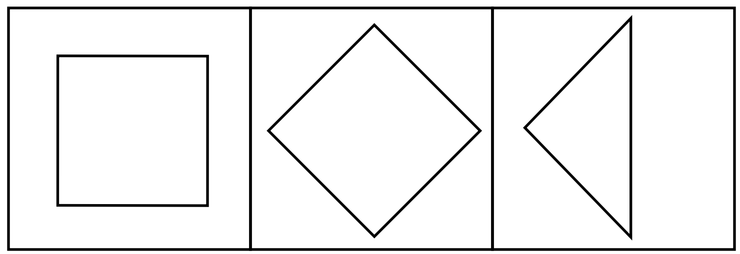


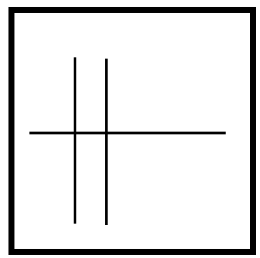


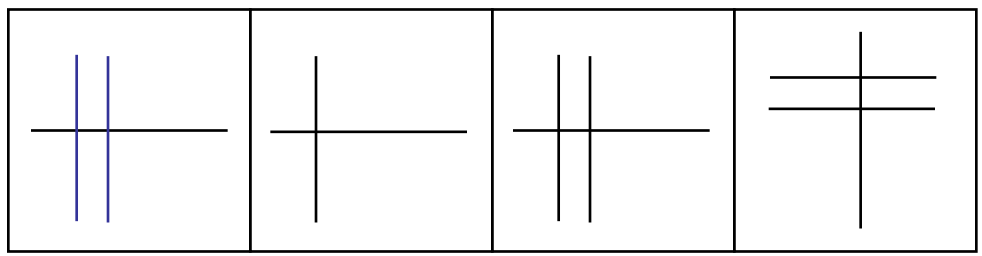


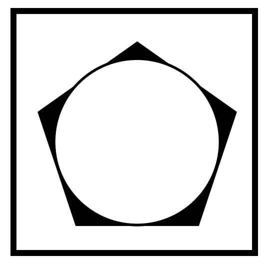


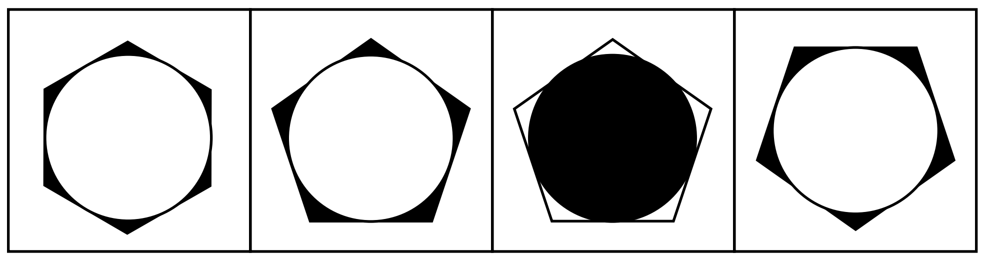


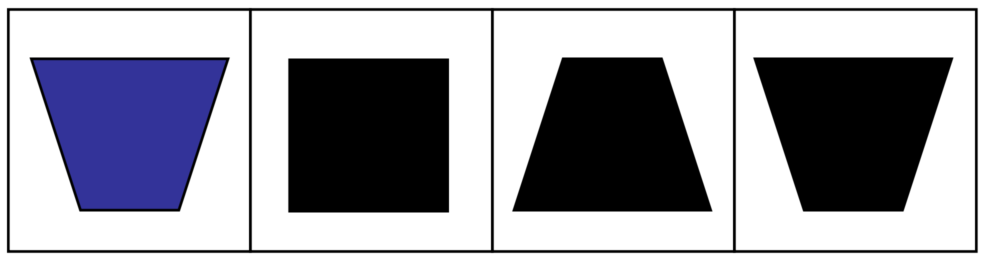


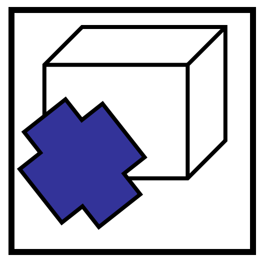


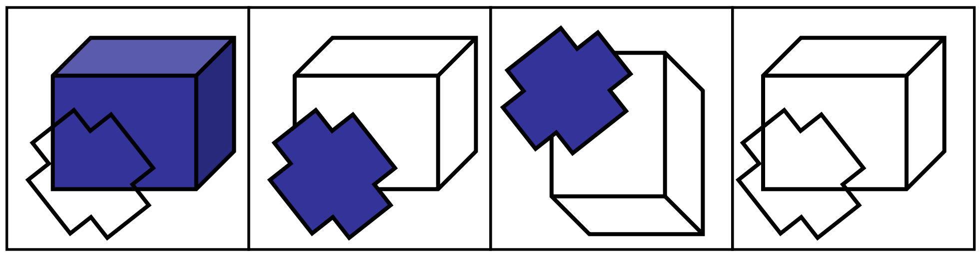


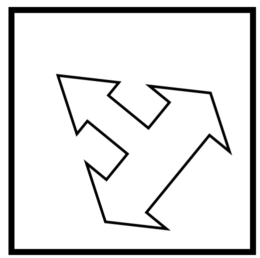


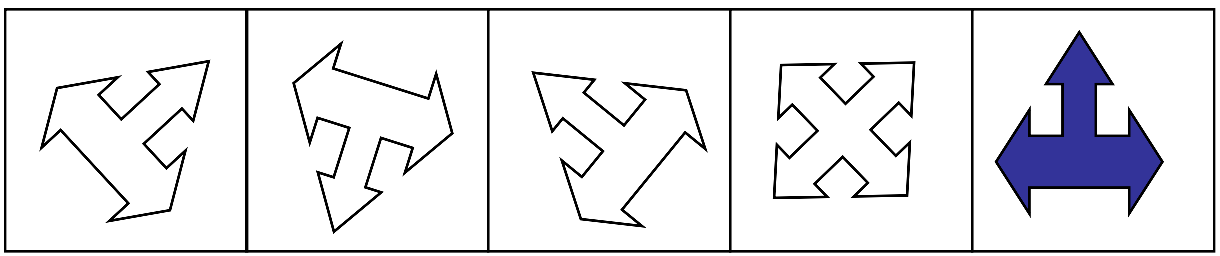


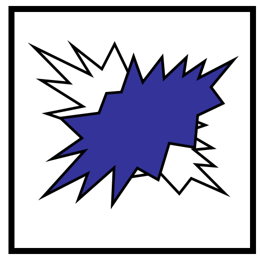


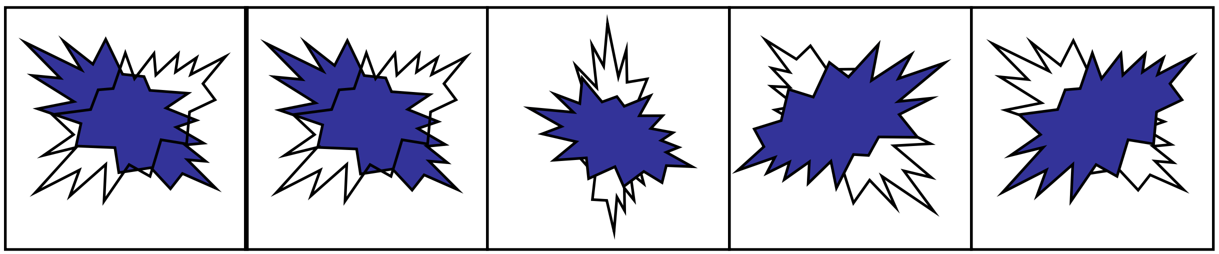


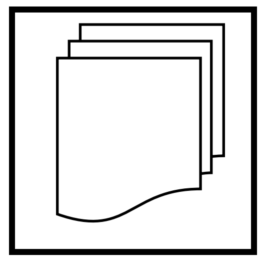


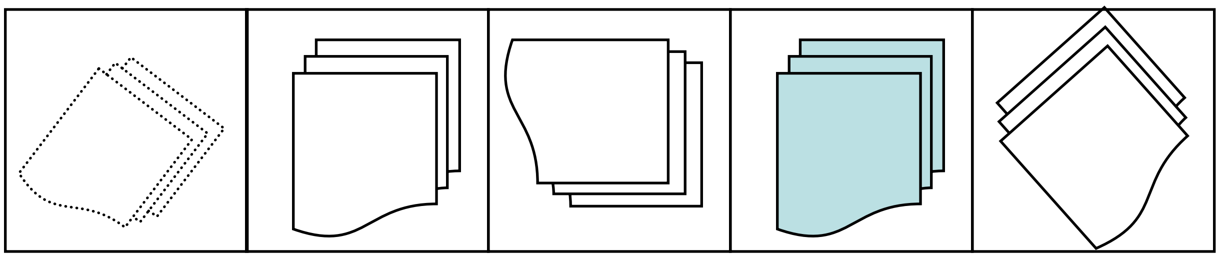


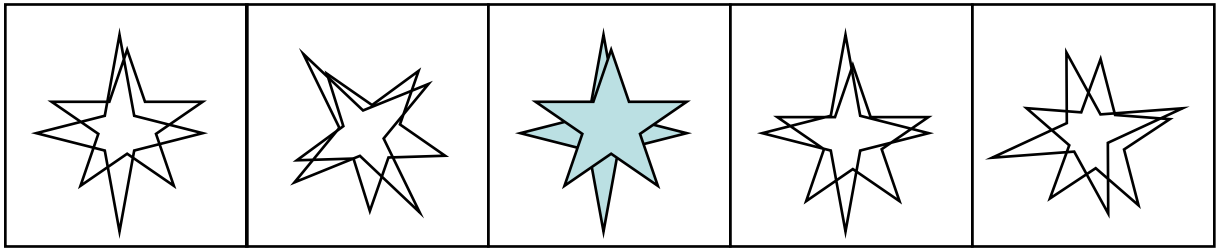


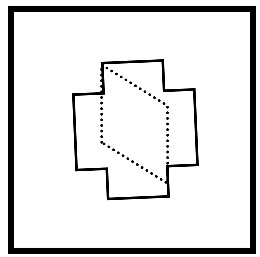


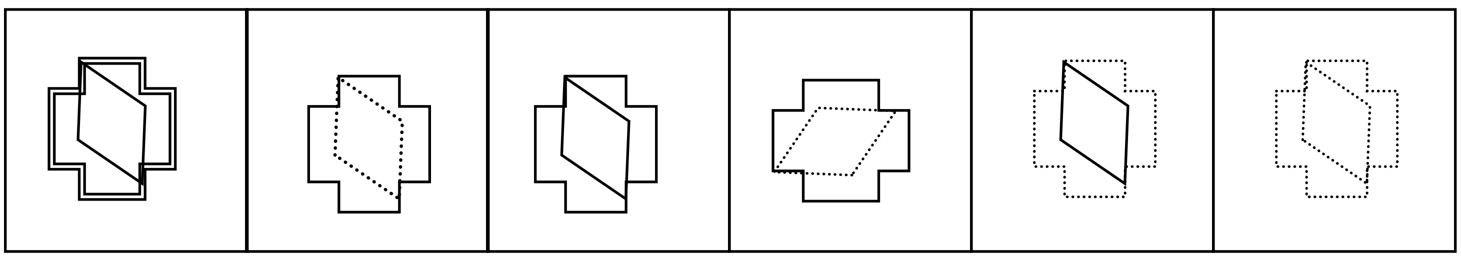


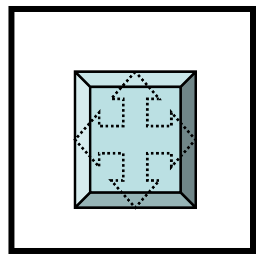


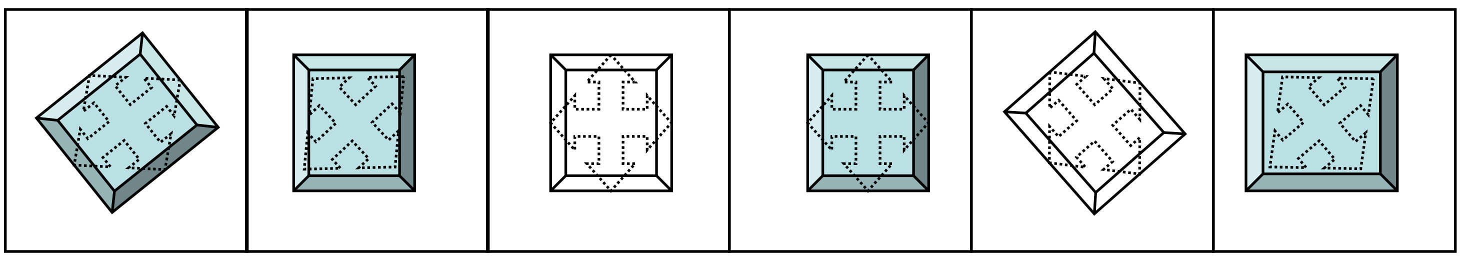


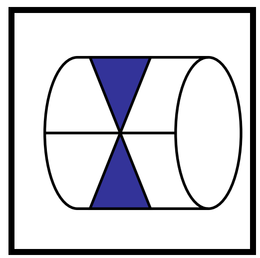


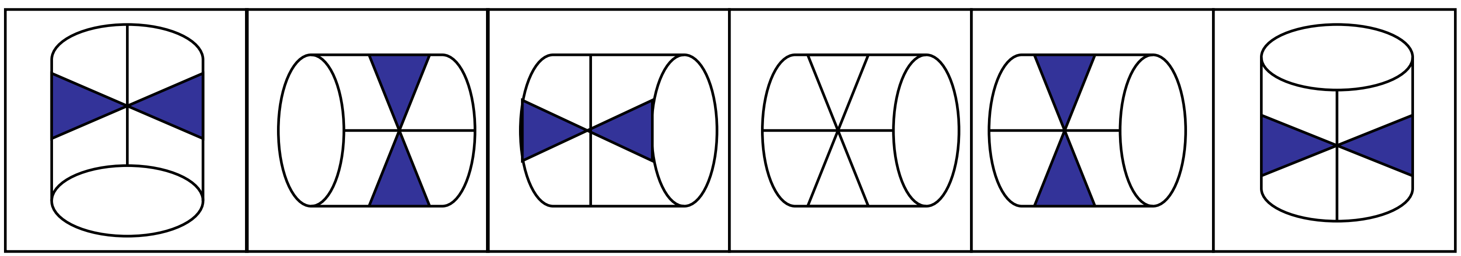


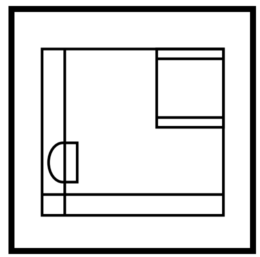


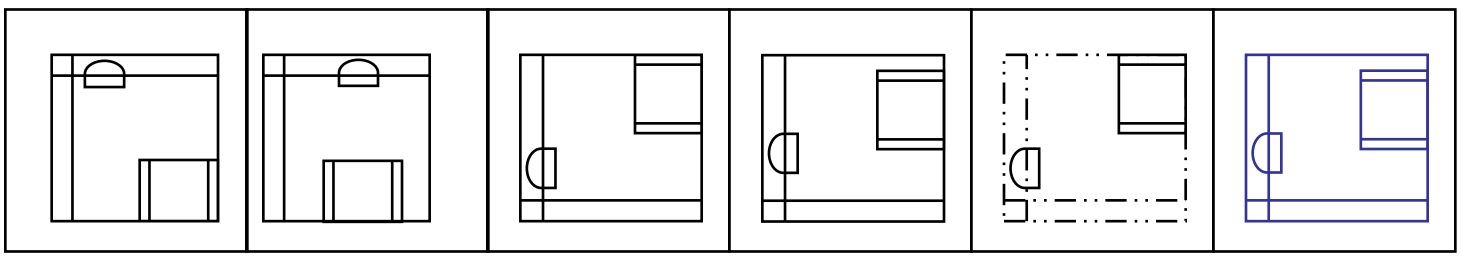












APPENDIX G

DIFFERENCE BETWEEN THE VISUAL PERCEPTUAL ASPECTS OF FOUNDATION PHASE BOYS AND GIRLS

To determine whether the various visual perceptual aspects differed between boys (group 1) and girls (group 2), the mean of each gender group was calculated and compared. The t-test was applied to determine whether the two means differed significantly. The results are reflected in Tables G1 to G3. As seen from the tables, there are no significant differences reflected.

For this study, it appeared that boys and girls demonstrate no significant difference in their ability to perceive visual stimuli with regard to visual perceptual aspects as presented in the VPAT. Certain researches studies (Bjorklund 2000:184-185; see section 2.8.2), identified in the literature study, were also unsuccessful in identifying any gender differences.

Therefore, this research study (see 2.6; 2.7.2 and Figure 2.4) and Bjorklund's findings contradict the research findings of Williams (1983:89-94), which clearly showed gender differences with regards to the development of visual perception aspects.

TABLE G1: DIFFERENCE BETWEEN THE VISUAL PERCEPTUAL ASPECTS OF GRADE1 BOYS AND GIRLS

Variable	Group	N	Mean	Std Dev	t value	*Df*	Probability
Visual Discrimination	1	15	8.73	1.58			
	2	26	8.04	2.99	0.83	39	p>0,05
Visual Spatial Relationships	1	15	11.00	1.96			
	2	26	10.08	2.68	1.16	39	p>0,05
Position-in-Space	1	15	10.00	3.40			
	2	26	8.92	4.32	0.83	39	p>0,05
Visual Closure	1	15	9.27	3.97			
	2	26	8.77	2.75	0.47	39	p>0,05
Visual Figure-Ground	1	15	7.40	3.70			
	2	26	7.31	2.92	0.09	39	p>0,05
Visual Analysis & Synthesis	1	15	6.87	2.85			
	2	26	7.04	2.22	0.22	39	p>0,05

TABLE G2: DIFFERENCE BETWEEN THE VISUAL PERCEPTUAL ASPECTS OF GRADE 2 BOYS AND GIRLS

Variable	Group	N	Mean	Std Dev	t value	*Df*	Probability
Visual Discrimination	1	18	9.28	2.59			
	2	16	10.25	1.98	1.22	32	p>0,05
Visual Spatial Relationships	1	18	9.72	3.56			
	2	16	11.13	3.28	1.19	32	p>0,05
Position-in-Space	1	18	12.11	2.35			
	2	16	12.88	2.19	0.98	32	p>0,05
Visual Closure	1	18	10.94	1.89			
	2	16	11.25	1.95	0.46	32	p>0,05
Visual Figure-Ground	1	18	9.67	3.34			
	2	16	10.50	2.83	0.78	32	p>0,05
Visual Analysis & Synthesis	1	18	8.56	2.75			
	2	16	9.31	1.85	0.93	32	p>0,05

TABLE G3: DIFFERENCE BETWEEN THE VISUAL PERCEPTUAL ASPECTS OF GRADE 3 BOYS AND GIRLS

Variable	Group	N	Mean	Std Dev	t value	*Df*	Probability
Visual Discrimination	1	15	10.80	1.21			
	2	28	9.79	2.64	1.40	41	p>0,05
Visual Spatial Relationships	1	15	12.67	1.50			
	2	28	11.89	1.50	1.61	41	p>0,05
Position-in-Space	1	15	13.00	1.25			
	2	28	13.18	1.66	0.36	41	p>0,05
Visual Closure	1	15	11.33	1.11			
	2	28	11.21	2.15	0.20	41	p>0,05
Visual Figure-Ground	1	15	10.73	2.34			
	2	28	10.75	3.48	0.02	41	p>0,05
Visual Analysis & Synthesis	1	15	9.07	2.02			
	2	28	9.50	2.73	0.54	41	p>0,05

APPENDIX H

Signs and symptoms of visual challenges within the classroom

(with permission of Lambert Fick)

Name: ______________________________

Grade: **R 1 2 3** Date:__________________

Signed: ______________________________

Teacher, Remedial Teacher, Psychologist, Vision Consultation, Others

1. EYES APPEARANCE

- ❐ Eyes tear excessively (watery eyes)
- ❐ Reddened eyes or lids
- ❐ One eye turns in or out at any time
- ❐ Frequent styes on lids
- ❐ Encrusted eyelids

2. COMPLAINTS WHEN USING EYES AT DESK

3.
- ❐ Headaches in forehead or temples
- ❐ Burning or itching after reading or desk work
- ❐ Nausea or dizziness
- ❐ Print blurs or moves after reading a short time

4. BEHAVIOURAL SIGNS OF VISUAL PROBLEMS

A. Eye Movement Abilities (*Ocular Motility*)

- ❐ Head turns as read across page
- ❐ Loses places often during reading
- ❐ Needs finger or marker to keep place
- ❐ Displays short attention span in reading or copying
- ❐ Too frequently omits words
- ❐ Repeatedly omit "small" words
- ❐ Writes up and down hill on paper
- ❐ Rereads or skip lines unknowingly
- ❐ Orients drawings poorly on page

B. Eye Teaming Abilities (*Binocularity*)

- ❐ Complains of seeing double (*Diplopia*)
- ❐ Repeats letters, numbers or phrases
- ❐ Misalign digits in number columns
- ❐ Squints, closes on covers one eye

<u>Working at a surface doing activities</u>

- ❐ Tilts head extremely
- ❐ Consistently shows gross postural deviations.

C. Eye-Hand Coordination Abilities

- ❐ Must feel of things to assist in any interpretation required
- ❐ Eyes not used to "steer" hand movements (extreme lack of orientation, placement of words of drawings on page)
- ❐ Writes crookedly, poorly spaced; cannot stay on ruled lined
- ❐ Uses hand or fingers to keep his place on the page.
- ❐ Uses other hand as "spacer" to control spacing and alignment on page
- ❐ Repeatedly confuses left-right directions

D. Visual-Form Perception

(*Visual Comparison, Visual Imagery, Visualisation*)

- ❐ Mistakes words with same or similar beginnings
- ❐ Fails to recognize same word in next sentence
- ❐ Reverses letters and/or words in writing and copying
- ❐ Confuses likenesses and minor beginnings and endings of words
- ❐ Fails to visualise what is read either silently or orally
- ❐ Whisper to self for reinforce (*sub-vocalising*)

E. Refractive Status

(*Nearsightedness, Farsightedness, Focus Problems, etc.)*

- ❐ Comprehension reduces as reading continued; loses interest too quickly
- ❐ Mispronounces similar words as continues reading
- ❐ Blinks excessively at desk tasks and/or reading; not elsewhere.
- ❐ Holds book too closely; face too close to desk surface.
- ❐ Avoids all possible near-centered tasks.
- ❐ Complaints of discomfort in tasks that demand visual interpretation
- ❐ Closes or covers one eye when reading or doing desk work
- ❐ Makes errors in copying from board to paper
- ❐ Squints to see board or requests to move nearer
- ❐ Rubs eyes during or after short periods of visual activity
- ❐ Fatigue easily; blinks to make board clear up after desk activities