ASSESSMENT OF LINGUISTIC AND COGNITIVE ABILITIES IN THE LEARNING DISABLED DEAF POPULATION

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DEDICATION

for Tessa Kibler,

deaf student and friend,

who inspired my interest in sign language and the world of deafness

DECLARATION

I, Dale Ogilvy, declare that this dissertation is my own unaided work, except for technical assistance as detailed in the Acknowledgements, that I am responsible for the text of this study and all conclusions reached; and that no part of this dissertation has been submitted for a degree at any other university.

Dale Ogilvy

26/1/95

Date

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I wish to place on record my indebtedness to the following people:

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the late Vivienne Simmons, for her exceptional ability in analysing sign language.

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ABSTRACT

This study set out to determine methods of identifying a specific subgroup of learning disabled deaf individuals - those with a language impairment. A South African Sign Language (SASL) test battery was developed for assessing sign language skills in the learning disabled deaf population. Linguistic and cognitive profiles for three learning disabled profoundly deaf adults and three nondisabled profoundly deaf adult controls was described.

The battery of diagnostic tests consisted of a standard battery of language tests adapted for SASL, formal sign language tests, a signed narrative discourse task and a cognitive test battery translated into SASL. The inclusion of a signed narrative task and its analysis method enabled an examination of higher order linguistic and cognitive skills and specific aspects of sign language which have not been previously investigated. The perception and production of facial expressions used for linguistic purposes in sign, the breakdown of this perception and production and the role of these facial expressions in the macrostructure of signed discourse were examined in this study. Although much research on the production of facial expressions and other nonmanual behaviours in sign language has been undertaken previously, to the writer's best knowledge no research concerning the perception of facial expressions in sign language, the breakdown in the perception and use of facial expressions in sign language and its role in the form of evaluative elements in the macrostructure of signed discourse have been previously undertaken. Furthermore the function of facial expressions as grammatical markers in sign language and other functions of facial processing not particular to signed languages were studied from a neuropsychological perspective. Studying the breakdown of sign language from a psycholinguistic perspective allowed for the identification of some of the underlying processes essential to sign language competence. A fundamental component of this study was the involvement of adult deaf native signers at all levels of the research.

The particular combination of tests used in this study revealed linguistic and cognitive deficits in the three learning disabled deaf (LDD) subjects which were not evident in the control subjects. It highlighted the similarities as well as the heterogeneity of the three LDD subjects' linguistic and cognitive profiles in terms of both the nature and degree of severity of the deficits. In addition it revealed deficits in some of the underlying processes in sign language, such as spatial and facial processing, as well as their manifestations in various forms. The numerous theoretical and clinical implications arising from the results of this study are discussed in detail.

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CHAPTER ONE
INTRODUCTION

> The study of sign language is intriguing from many perspectives. It holds promise of providing new insights into the structure of human language and communication systems, the nature of human perception, memory and production mechanisms, and the relationship between language, meaning and culture. (Hoffmeister and Wilbur, 1980, p.61)

Stokoe (1978) noted that the study of sign language has two primary ends: to gain knowledge about what language is, and to help forward the education of the deaf.[1] In this study the writer has endeavoured to meet both these goals.

The purpose of this study was to determine methods of identifying a specific subgroup of learning disabled deaf individuals - those with a language impairment. The rationale develops from the fact that previously this subgroup seems to have been neither adequately identified nor appropriately treated.

In South Africa, sign language is the primary language for the majority of deaf adults. However in the current educational setting, English, in either spoken or signed form, is the predominant language. For reasons which will be expanded on in Chapter Three, the recognition and use of sign language has generally been overlooked. Hence the fact that deaf individuals may already have a diverse linguistic and communicative repertoire in sign is often not recognised or accepted. Although the sign language abilities of deaf individuals may not be tied to competence in English, little is known about their skills in sign language. This has largely occurred because of the lack of focus on sign language and the lack of measurements to assess sign language. The current measurements do not provide sufficient information to gain a complete understanding of the linguistic abilities of deaf individuals.

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[1] The term 'deaf', as used in this dissertation, refers to persons with a profound congenital hearing loss, who share a common cultural heritage, a common language (sign language), and a common sense of identity with the Deaf Community.

Pervasive language deficits (in spoken/written language) among the deaf population have been well documented. However there is no empirical evidence to suggest that the linguistic deficits commonly noted among the deaf include impairments in sign language. Thus at this stage it is not possible to determine the presence of a "general language impairment" in deaf individuals.

Professionals in hearing impairment have had little doubt that a substantial number of hearing impaired individuals also have learning disabilities (Bunch and Melnyk, 1989). Currently 5-7% of hearing impaired students in programmes for the hearing impaired in the USA are classified as "deaf learning disabled" (Craig and Craig, 1985). Despite the pervasive language deficits of the hearing impaired in general, and the fact that language deficits are probably the most pervasive problem of (hearing) learning disabled individuals (Wiig and Semel, 1984), to the best of the writer's knowledge, no studies on the formal assessment of sign language within the learning disabled deaf population have been reported to date. Furthermore there is a paucity of literature on the learning disabled deaf population. Few studies regarding the identification and characteristics of learning disabilities in the deaf population are available. Auxter (1971) attempted to determine differences in academic learning ability in deaf populations comparable in chronological age and IQ. He speculated that perceptual motor differences could distinguish atypical deaf learners from their peers. Although significant differences were found between the groups on perceptual motor tasks, his study has been criticised for theoretical and methodological flaws (see Vockell, Hirshoren and Vockell, 1972). Marlowe (1991) conducted a study in which nonlinguistic serial memory tasks were used to distinguish between learning disabled and normal secondary students within both the hearing and deaf population groups. His findings indicated that performances on nonlinguistic serial recall tasks did indeed distinguish between learning disabled students and their normal peers regardless of hearing status. Nevertheless, although the experimental evidence from the above study may provide a major contribution towards the identification of the learning disabled deaf, it does not assist in the identification of any subgroups of learning disabled deaf, more particularly the language impaired subgroup. In fact little recognition and mention was made by Marlowe (1991) of the pervasive language impairments found among the hearing learning disabled group and among the deaf population in general. On the other hand, the results from several national surveys conducted in the United States

of America, which examined learning disabilities in the hearing impaired population, have indicated that language impaired was one of the labels most often given to those deaf persons identified as learning disabled (Powers, Elliot and Funderburg, 1987; Elliot, Powers and Funderburg, 1988; Elliot and Powers 1988; and Powers, Elliot, Fairbank and Monaghan, 1988). Moreover Powers et al (1988) noted that, as can be determined from the results of the surveys, differences in language abilities may be a criterion that differentiates hearing impaired from learning disabled hearing impaired. Although the results from these surveys have highlighted the pervasiveness of linguistic deficits among the learning disabled deaf, these results were only based on ratings of effective use of sign or speech for communicative purposes and no formal systematic attempts were made to account for the nature of the spoken or sign language deficits.

Similarly, little research has been conducted on the nature of sign language impairments in other language [illegible] population groups. As noted by Poizner, Klima and Bellugi (1987), [illegible] of the grammatical structure of sign language, which have made possible the analysis of the nature of breakdowns in sign language, have only recently become available. Poizner et al (1987) developed a sign language battery and reported the sign language impairments (in American Sign Language - ASL) of three deaf aphasic patients. The primary purpose of their investigation, which was conducted within a neurolinguistic framework, appeared to be one of determining cerebral dominance and specialisation for sign language and the localisation of the sign language system and its components.

In summary, from a review of the literature, there is a dire need for further development of assessment tools to examine sign language skills in the deaf population as well as research on the nature of breakdowns in sign language, particularly within the learning disabled deaf population.

This study had two main aims. Firstly it aimed to develop a South African Sign Language Battery in order to assess sign language skills in South African deaf adults. Using this

sign language battery and a cognitive test protocol,[2] the second aim was to describe the linguistic and cognitive profiles of three learning disabled profoundly deaf adults and three nondisabled profoundly deaf adult controls in the context of the interrelated disciplines of linguistics and cognitive psychology.

In this study a parallel case study design was employed as it has been argued that the only valid methodology for research with brain damaged patients is one based on single patient studies (Caramazza, 1986; Caramazza and McCloskey, 1988; Caramazza, 1991). Furthermore the involvement of three case studies would allow for any possible similarities and differences in performance between the three cases to be revealed.

In contrast to the emphasis placed on neuroanatomic localisation in the study conducted by Poizner et al (1987), the study was conducted from a clinical psycholinguistic perspective. As described by Crystal (1984), clinical psycholinguistics takes into account from the outset the relationship between linguistic behaviour and such psychological factors as memory, attention and perception, in attempting to explain language breakdown. Each subject's results on the cognitive test protocol, which included tests for some of these psychological factors, were used to assist in the interpretation of linguistic breakdown in sign (in South African Sign Language - SASL). In addition the inclusion of nonlanguage spatial tests in the cognitive test protocol allowed for any dissociations of language and nonlanguage spatial functions in sign language to be revealed.

In the assessment of the subjects' sign language skills, much emphasis was placed on the examination of the underlying processes of spatial and facial processing, which are unique to signed languages. In this study, like that of Poizner et al (1987), an investigation into both the perception and production of spatial processing in sign language was undertaken. However unlike the study conducted by Poizner et al (1987), which did not report an assessment of facial processing in sign, this study examined the perception and production of facial expressions and nonmanual behaviours in sign language. Furthermore the role

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[2] The terms 'cognitive test protocol' was adopted in this study rather than 'cognitive test battery' as the cognitive tests selected did not comprise a full battery in the traditional sense of the word (as a result of no redundancy and overlap), but meaning a range or profile of significant subconstructs traditionally examined in a neuropsychological battery.

of facial processing in sign language was also studied from a broader neuropsychological perspective.

In this research the writer was also motivated by some recent conceptual shifts which have occurred in the field of linguistics. Some of these are now discussed.

The inclusion of discourse analysis in the assessment of sign language in this study was motivated by the recent shift of inquiry into language acquisition and use from the analysis of single words and sentences to that of larger units of discourse. Analysis of discourse allows for the simultaneous examination of linguistic and communicative aspects and cognitive processes (Glosser and Deser, 1990; Joanette, Goulet, Ska and Nespoulous, 1986; Mentis and Prutting, 1991). In addition, manifestations of the underlying spatial and facial processes in sign language may be examined within discourse. The analysis of discourse in sign language is a recent development and little research on the breakdown in discourse forms in sign has been reported. To the best of the writer's knowledge, analysis of signed discourse within the learning disabled deaf population has not previously been undertaken.

Concurrent with this shift in emphasis from an analysis of words and sentences to longer linguistic units, including discourse, is the awareness of the long-term effects of language disorder. Results from follow-up studies of hearing children who present with language disorders early in life show that, even after intervention, language disorders persist throughout the school years and even through adulthood (Wiig, Lapointe and Semel, 1977; Wallach and Liebergott, 1984; Merrit and Liles, 1987; Purcell and Liles, 1992). It is within the adult population that this study was conducted.

From the outset of this study, involvement of the deaf in all stages of the investigation was emphasised. Adult deaf native signers were involved in test construction, administration and scoring. The importance of the use of deaf native signers in all three stages of the investigation has been highlighted by Kyle (1983) who claimed "Deaf people don't use signs that we hearing people know". He stated that he didn't believe the problem was as simple as a secret vocabulary among deaf people nor as simple as the difference between Manual English and sign language. He attempted to explain it as

"something as vague as the way language is used but as explicit as the processes internally which control the way the language is constructed before it is articulated" (Kyle, 1983, p.184). Lucas (1989), who acknowledges the distinction between the sign language used by deaf people and that used by hearing people, noted that informal observation and anecdotal evidence suggest that this distinction is an important variable in the outcome of language contact in the deaf community. Deaf individuals not only usually sign differently with other deaf individuals than with hearing individuals but also have been observed to initiate an interaction in one language and radically switch when the interlocutor's ability to hear is revealed. Once the hearing ability becomes apparent, it is not unusual for the deaf person to switch away from ASL to a more English-based form of signing. Code choice is thus sensitive to the ability or inability of participants to hear and this distinction has been carefully attended to in this study.

This research has been primarily targeted at the profoundly deaf population (better ear averages of 90dB or more). A major source of variability which is frequently uncontrolled or unreported within research on deafness is the degree of hearing loss of subjects (Hyde and Power, 1992). Hyde and Power (1992) note that hearing levels are often only reported as severe or profound or, worse still, severe to profound. The target population of profoundly deaf individuals was based on observations made by the writer and in support of those studies such as that conducted by Hyde and Power (1992), which indicated the greater need for signed communication among profoundly deaf individuals whereas within the severely deaf population some individuals appear to cope without signing.

The scope of this study involves both applied and theoretical aspects. The development of a South African sign language test battery has numerous clinical applications. Within the framework of this study it allowed for the identification and description of sign language impairments exhibited by learning disabled deaf adults. However it is anticipated that this battery could be used within the nondisabled deaf population and within other neurologically impaired deaf population groups in the future. It also has remedial implications for the language impaired learning disabled deaf individual. Only once sign language impairments have been identified and described can programmes of remediation be planned and implemented.

Numerous theoretical implications may evolve from this study. Apart from providing detailed descriptions of the linguistic and cognitive skills of language impaired learning disabled deaf adults, comparisons may be drawn between the patterns of breakdown in sign language of learning disabled deaf persons and breakdowns in the spoken languages of hearing learning disabled persons. This in turn could provide us with more information regarding language in general and its underlying processes. Furthermore, by conducting this study from a clinical psycholinguistic approach, in which both impaired and intact linguistic and cognitive processes for the three learning disabled deaf subjects will be described, some preliminary conclusions concerning normal and intact sign language and cognitive processes among the adult deaf population may be ascertained.

1.1 DESCRIPTION OF CHAPTERS

Chapter Two focuses on the patterns of signed morphology, syntax and discourse with particular reference to South African Sign Language. Parallels are drawn between South African Sign Language and other signed languages such as American Sign Language and British Sign Language concerning spatially organised syntax and discourse, facial expressions and nonmanual behaviours as grammatical functions in sign language, and related noun and verb pairs. Moreover, it is argued that SASL is a distinct language in its own right.

In Chapter Three, a discussion of learning disabilities in the hearing and deaf population groups is undertaken. It is argued that at present, due to numerous difficulties, the learning disabled deaf population and the specific subgroup of language impaired learning disabled deaf are not properly identified. Linguistic and cognitive aspects such as narrative discourse and memory, which were included in the assessment process in this study and are considered to be important in the assessment, identification and description of the learning disabled person were discussed. Furthermore an analysis of the cognitive processing capacities of the deaf was undertaken, as there has been much controversy and debate concerning the intellectual potential of the deaf which in turn has a direct effect on the identification of the learning disabled deaf population.

Chapter Four concerns the methodology of this study. The aims, underlying principles of test construction, test construction and description, subjects, data collection methods and data analysis methods are described.

The findings of the study and a discussion of the results are presented in Chapter Five.

Chapter Six contains a general discussion and includes conclusions and implications pertaining to this study.

CHAPTER TWO

SIGNED MORPHOLOGY, SYNTAX AND DISCOURSE, WITH PARTICULAR REFERENCE TO SOUTH AFRICAN SIGN LANGUAGE

In this chapter a brief overview of the status of sign language research in South Africa and the nature of signed morphology, syntax and discourse with particular reference to South African Sign Language (SASL) is undertaken. Parallels are made with other natural sign languages such as American Sign Language (ASL) and British Sign Language (BSL), which have been well documented in the literature. Although direct inferences cannot be made about the structure of SASL from findings in respect to other signed languages, such information has provided suggestions as to the types of patterning which may occur. The morphological, syntactical and discourse structures examined in this study form the focus of this chapter. A fully comprehensive account of the morphology and grammar of SASL would require multiple research projects.

2.1 THE STATUS OF SIGN LANGUAGE RESEARCH IN SOUTH AFRICA

Although sign language is the primary language of the deaf communities in South Africa, the linguistic study of South African Sign Language is still very much in its infancy. Although informal, unsystematic attempts to document particular signs used by the deaf in South Africa had occurred earlier (Neider-Heitmann, 1980), the recognition for the need for formal study of sign language in South Africa began only in 1983 (Human Sciences Research Council (HSRC), 1983). A national research programme, under the joint auspices of the HSRC and the South African National Council for the Deaf, was undertaken (Penn and Reagan, 1990). The primary aim of the project was the compilation of a dictionary of the signs used by the different deaf groups in South Africa (Penn, 1992). A secondary outcome of the SASL Research Programme was the preliminary description and analysis of the syntactic, morphological and pragmatic aspects of SASL (Penn, Reagan and Ogilvy, 1991). A necessary prerequisite to this study was a preliminary investigation into the morphological, syntactical and discourse structures of SASL. For this preliminary investigation, signed narrative discourse samples were obtained from five prelingually deaf adults who use SASL as their primary means of

communication. They had all attended the same deaf school in Johannesburg and are presently integral members of the Johannesburg deaf community. All five were under the age of forty-five years, and right-handed, and none had handicapping conditions apart from their deafness. The signed language samples were videotaped and later analysed by trained deaf and hearing judges. Only selected aspects of SASL morphology, syntax and discourse were targeted in this preliminary analysis (Ogilvy, Penn and Reagan, in press). Primary characteristics were found in SASL equivalent to those found in more well researched sign languages such as ASL and BSL, which it is hoped will allow us to reach the point where we can discuss what the "data mean" rather than what the "data are" in a shorter space of time and in line with ongoing sign language research elsewhere (Stokoe, 1991).

2.2 SPATIALLY ORGANISED SYNTAX AND DISCOURSE

Spoken languages have different ways of determining grammatical relations among their lexical items. In English, grammatical relations among the verb and its arguments are determined largely by word order. However in natural sign languages which have been subjected to linguistic analyses, grammatical relations among signs are largely determined by the manipulation of sign forms in space. Hence in ASL as well as other natural sign languages it is space itself which carries linguistic meaning (Bellugi, Van Hoek, Lillo-Martin and O'Grady, in press). As noted by Bellugi et al (in press), Hoemann (1978), Klima, Poizner and Bellugi (1988) and Van Hoek (1988), the most prominent and distinctive use of space in ASL is its role in syntax and discourse. This effective use of spatial organisation can be well illustrated in nominal assignment, pronominal reference and verb agreement.

2.2.1 Nominal Assignment, Pronominal Reference and Verb Agreement

Nominals, people or other referents, introduced into the discourse are assigned arbitrary and spatially distinct loci in a horizontal plane of signing space in front of the signer's body. Subsequently these loci serve as the spatial indices of the assigned nominals (Klima, Poizner and Bellugi, 1988; Bellugi et al, in press; and Van Hoek, 1988). Nominals which are physically present in the discourse environment are associated with

loci corresponding to their conceived spatial locations and an abstract use of space occurs when nominals either physically or temporally absent are assigned arbitrary loci in the signing space. Any subsequent reference to that locus either by pointing, gazing, shifting the body or by verb agreement clearly refers back to that previously mentioned nominal even when many other signs have intervened (Bellugi et al, in press; Bellugi, 1988; and Van Hoek, 1988). These arrays of loci are referred to as the "fixed referential framework" as the referents remain established at these loci throughout a stretch of discourse unless otherwise changed to new loci by the addresser. When this frame of reference is shifted, the shift can have several forms. Lillo-Martin and Klima (1990) note that one form, sometimes referred to as role playing, includes modifying facial expression, body posture and style of signing. However the referents remain ambiguous within the grammatical structure of the individual sentence or of the discourse frame.

Within the discourse frame, pointing again to a specific locus unambiguously refers back to a previously established nominal. It is with such indexic pronouns (pointing sign forms) that pronominal reference is carried out (Klima et al, 1988). Poizner et al (1988) note that in ASL any subsequent reference to a locus, whether by verb agreement or by pointing, is equivalent of pronominal referencing. Pronominal referencing in ASL forms part of the spatial indexing system (Klima et al, 1988). Figure 2.1 illustrates this process of nominal and pronominal assignment, using data obtained in SASL.

In this and other figures, the SASL signs are glossed by English words written in upper case letters. The referential loci are indicated by subscript letters. Beneath certain glosses, half circles, representing the signing space in front of the signer, are drawn with arrows indicating the positions of the specific loci. In this example, a fixed framework is illustrated. The mother is referred to locus a; the children to locus b; the boy to locus c and the girl to locus d. These referential loci remain established throughout this stretch of discourse. This sample was elicited using the "Cookie Theft Picture Description Task" of the Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1983) and is translated into English as follows:

> In the kitchen, mother starts washing. After they have finished tea, she washes the dishes. Two children are stealing biscuits, and taking advantage, because their mother is deaf. The mother cannot hear the water flowing. She never saw the water flowing. The girl tells the boy to hurry up and give the biscuits to her, but he wants them for himself.

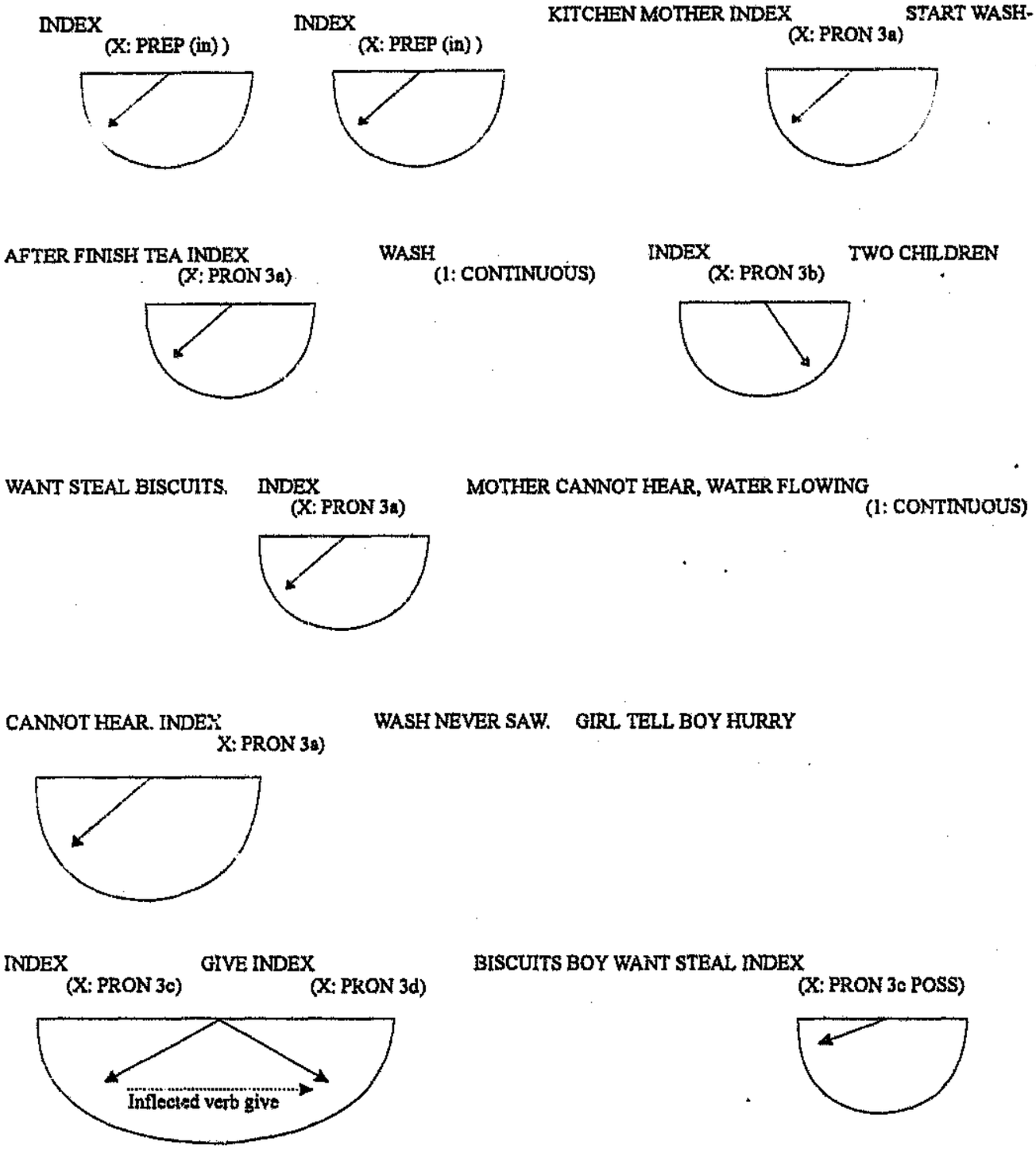
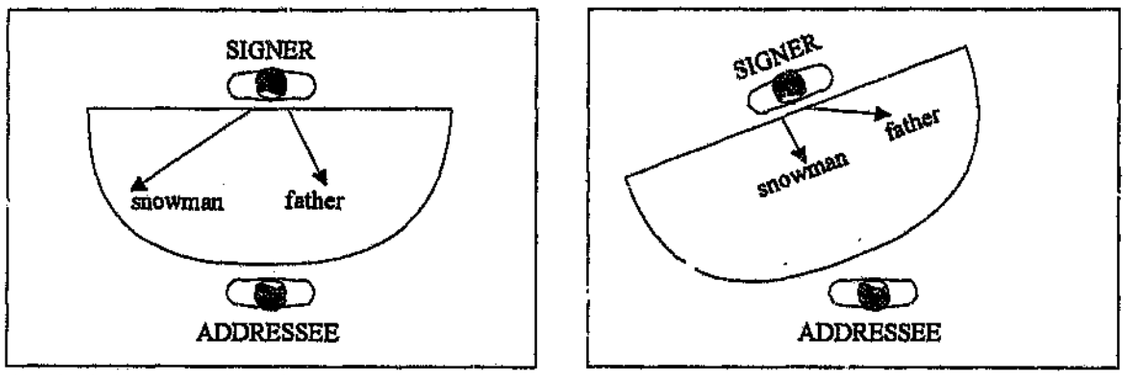


Figure 2.1: An illustration of nominal and pronominal assignment in SASL

Shifts in the frame of reference were noted during other discourse tasks. During these shifts the third person referents were assigned to the locus in front of the signer's body, which usually denotes self-reference. The whole spatial plane rotated and previously established nominals were now associated with new loci. An example of a shift in the frame of reference is illustrated in Figure 2.2. Diagram A shows a fixed framework in which the third person loci remain constant. Diagram B illustrates a shifting framework in which the whole spatial plane has rotated and previously established nominals are assigned to new spatial loci. This shift occurred in the form of role-playing when the third person "snowman" was role-played in front of the signer's torso.

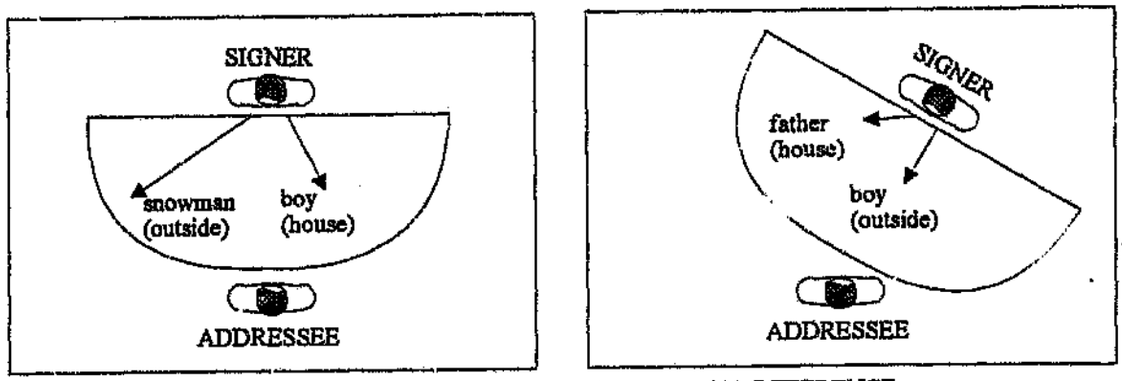


(A) FIXED FRAMEWORK (B) SHIFTING REFERENCE

Figure 2.2: Fixed and shifting frames of reference in SASL

The example of a single locus representing both a spatial location and a person (or other referent) noted by Van Hoek (1988) in relation to ASL, was also observed in our SASL data. As noted by Van Hoek (1988) it would have been ungrammatical to have used two distinctly separate loci when referring to the location and to the person who is occupying that location.

Figure 2.3 illustrates an example of "locus shifting" found in our data. This phenomenon of "locus shifting" was first described by Padden (1983, in Van Hoek, 1988) and occurs when the locus used to refer to the physical location of a person is shifted to indicate physical movement on the part of the referent.



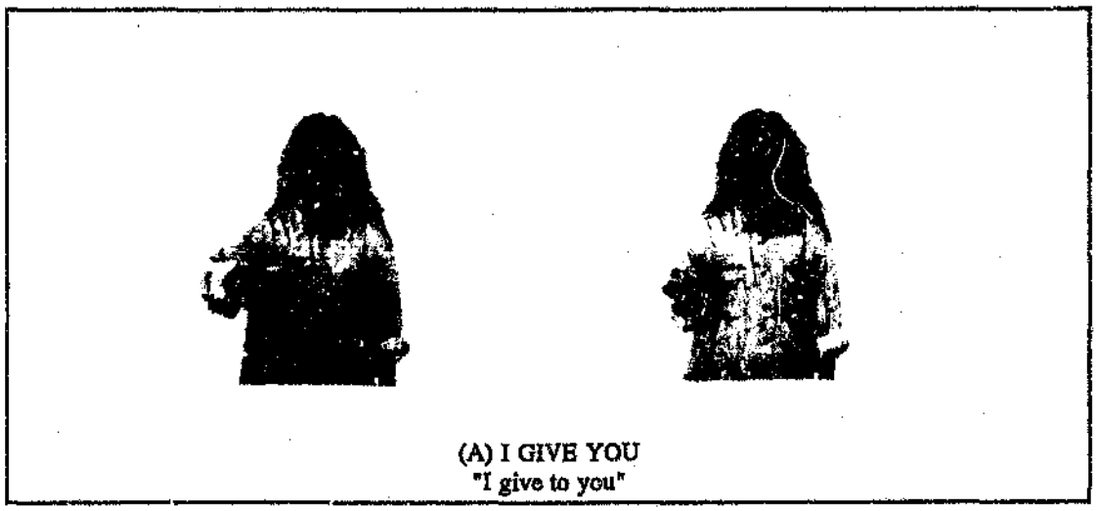
(A) FIXED FRAMEWORK (B) SHIFTING REFERENCE

Figure 2.3: Fixed and shifting frames of reference, including locus shifting, in SASL

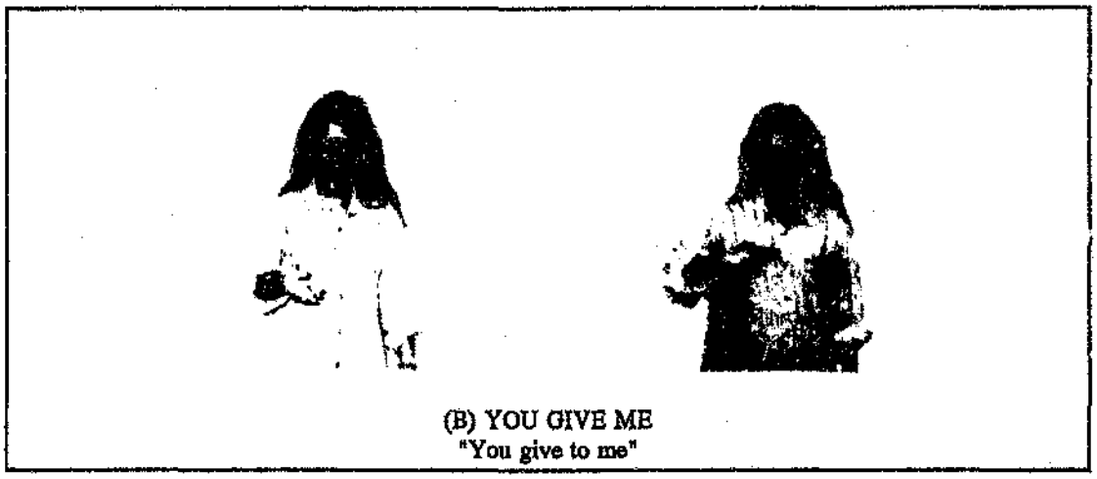
Indexic pronouns (pointing sign forms) which refer back to previously established nominals within a discourse frame were used frequently in all of the SASL data we obtained and resembled closely that found in other natural sign languages.

Pronominal referencing by verb agreement was frequently noted in our data. In the system of verb agreement grammatical relations are specified in natural sign languages. In ASL, for example, a large class of verbs are inflected as their direction of movement is mutable (e.g., "force", "give", "encourage", "urge" and "permit" (Klima et al, 1988). For many of these verbs, the initial point (the indexed locus from which the verb stem moves) is the subject of the verb, and the final point is its grammatical object. The same signs maintained in the same order, but with a reversal in direction, determine a reversal of grammatical relations. In our data, large classes of inflected verbs were also noted. Examples of such verbs included "give", "leave", "walk", "call", "go", "welcome", "invite" and "fetch" (see Figure 2.4 for an illustration of an inflected SASL verb).

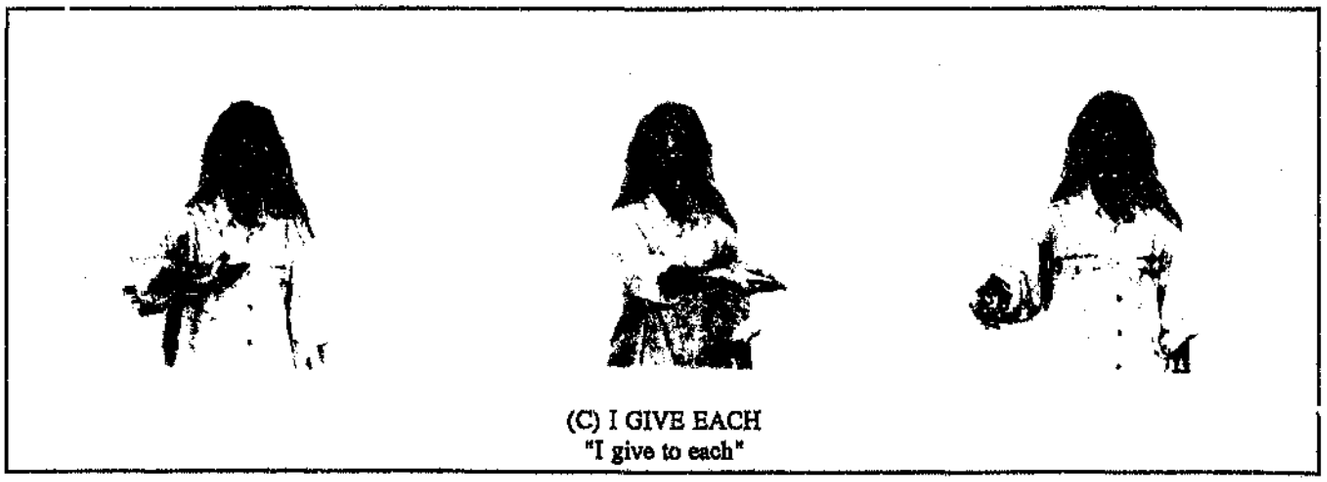
In summary, the data obtained thus far suggest that the use of space and spatial referencing in nominal assignment, pronominal referencing and verb agreement in SASL parallels that found in other natural sign languages. Further, the data lend support to the notion that the primary characteristic of sign language is its spatial aspect, a phenomenon which appears to be universal amongst natural sign languages (Volterra, 1981; Lillo-Martin, 1992).



(A) I GIVE YOU
"I give to you"



(B) YOU GIVE ME
"You give to me"



(C) I GIVE EACH
"I give to each"

Figure 2.4: A example of an inflected SASL verb, "give", illustrating the mutable direction of movement

2.2.2 The Use of Spatial Referencing as a Cohesive Device at the Discourse Level in Sign Language

Cohesion in signed discourse can be created by various linguistic features, namely, repetition of signs, use of spatial referencing and the use of conjunctions (Winston, 1991). The analysis of cohesion and more particularly the use of spatial referencing as a cohesive device at the discourse level in sign language is rare. Cohesion is part of the text forming component in the linguistic system. It is the means whereby elements that are structurally unrelated to one another are linked together, through the dependence of each on the other for its interpretation. Where the interpretation of any item in the discourse requires making reference to some other item in the discourse, there is cohesion (Halliday and Hasan, 1976). Winston (1991) notes that cohesion in signed discourse is not a process used by a speaker but rather involves the entire effect which is created when the individual utterances combine to form a complete text. As discussed earlier in this chapter, the most distinctive use of space in sign language is in its role in syntax and discourse, especially in nominal assignment, pronominal reference, verb agreement, anaphoric reference and the referential spatial framework for discourse. Winston (1991) notes that individual signs, such as agreement verbs, use space as part of the meaning of the signs. Furthermore entire utterances and entire segments of discourse are signed within this space to make reference to previous established entities, thus producing cohesion.

According to Winston (1991) spatial referencing can be accomplished using a variety of means, including some of the following:

- articulating the sign for the referent in the space;
- physically stepping into the space and producing the sign(s);
- indexing to the space, and articulating the sign either in an unmarked space in front of the chest or within the marked space (or vice versa);
- directing eye gaze at the space;
- switching hands from dominant to non-dominant in order to articulate the sign with the hand on the side nearest the established space;
- using agreement verbs which inflect through movements towards/away from subjects and/or objects;
- using a combination of the above strategies.

Winston (1991) refers to one type of cohesion referencing system as "performatives". "Performatives show the action and persona of a speaker" (Winston, 1991, p.404). Liddell (1980) notes that the adoption of roles in discourse has also been referred to as "role playing" and "role shifting". He notes that the adoption of character roles in discourse is common. Constructed dialogue is one type of performative that portrays the "voice" of the speaker. This is achieved by the shifting of the head and/or the body position from one side to another, indicating each communicating with the other (Winston, 1991). This type of referencing includes the direction of the eye gaze at the other character as well as the signs being directed towards the other character. This shifting enables the observer to watch the change of speakers throughout the dialogue (Winston, 1991). The use of performatives in constructed dialogues, as described by Winston (1991), was clearly illustrated in SASL discourse samples.

2.3 FACIAL EXPRESSIONS AND NONMANUAL BEHAVIOURS AS GRAMMATICAL FUNCTIONS IN SIGN LANGUAGE

Facial expressions, as well as posture, movement and orientation of the head and body, serve important linguistic and grammatical functions in natural sign languages (Baker and Cokely, 1980; Brennan, 1992; Douglas, 1993; Humphries and Padden, 1992; Liddell, 1980; Bergman, 1984; Kyle and Woll, 1983). Nonmanual signals convey significant linguistic information and are critical in marking certain grammatical structures. Liddell (1980) argues that the importance of nonmanual activity is highlighted when one considers that neither word order, subordination nor relativisation can be discussed in any sort of depth without reference to nonmanual signals. In ASL, the scope of grammatical facial expressions, unlike affective facial expressions, is highly constrained and clearly rule-governed (see Liddell, 1980; Baker-Shenk, 1983; Reilly, McIntire and Bellugi, 1990). For example, grammatical facial expressions have clear onset and offset patterns, and their coordination with manual signs is crucial in indicating the scope and meaning of such signs.

McIntire and Reilly (1988) and Brennan (1992) note that research findings on nonmanual behaviours and facial expressions indicate that in ASL such signals function as grammatical markers in three basic ways. First, they mark specific syntactic structures,

e.g. topics and relative clauses. A second major function of nonmanual behaviours is in representing adverbs, and the third function is to accompany specific lexical items. In our data, distinct nonmanual signals within each of these three groups were also observed.

2.3.1 Syntactic Functions

2.3.1.1 Questions

In ASL nonmanual behaviours are used to mark questions. Yes/no questions are indicated with eyebrows raised and the head tilted slightly forward (Liddell, 1980; Humphries and Padden, 1992). Liddell (1980) notes that sometimes an eyebrow alone is sufficient to indicate a yes/no question.

"Wh-" questions use question words or signs which in English often begin with "wh" ("what", "who", "where", etc). The nonmanual behaviours which accompany "wh-" questions consist of a brow squint (although the brows are sometimes also raised as well as drawn together) and, frequently, a tilting of the head. Sometimes the body shifts forward and sometimes the shoulders are raised (Bellugi and Fischer, 1972, in Liddell, 1980; Stokoe, Casterline and Croneberg, 1965; Baker, 1976).

The nonmanual signal plays a determining role in the identification of questions since the facial expression and body movement alone can signal a question, but signs alone cannot; moreover interpretation of the type of question depends on facial expression and body movement (Liddell, 1980).

Our data on SASL confirmed all of these nonmanual behaviours; however, it is interesting to note that in SASL the use of eyebrows squinting was also sometimes observed in yes/no questions. It was not clear whether this behaviour may be contextually constrained, and this is an area for further research.

2.3.1.2 Negation

Nonmanual behaviours accompanying a string of signs to mark negation have been described by various researchers for different sign languages in different parts of the world. (See Stokoe, 1960; Bellugi and Fischer, 1972; Liddell, 1980; Padden, 1981; and Veinberg and Wilbur, 1991, for a review of ASL; Bergman, 1984 for Swedish Sign Language; Coerts, 1990, in Veinberg, 1993, for Sign Language of the Netherlands and Veinberg, 1993, for Argentine Sign Language). In ASL nonmanual grammatical signals can negate sentences without the use of a negating sign. For example, negation can be indicated by a side to side head shake, a frown, a brow squint, a wrinkling of the nose, or a raised upper lip (Bellugi and Fischer, 1972; Veinberg and Wilbur, 1991). In the narratives provided by our informants, the nonmanual grammatical signals used to indicate negation were the same as those documented in ASL.

2.3.2 Representation of Adverbs

A number of verbs in ASL can be modified through exclusively nonmanual adverbial features. Liddell (1980) has identified several nonmanual adverbs, including "mm" which indicates relaxation and enjoyment, as well as something that is normal and/or proper. This nonmanual adverb is made by keeping the lips together, and pushing them outwards, with the position of the head slightly back and to one side (Liddell, 1980; McIntire and Reilly, 1988) (see Figure 2.5). Thus the ASL sentence:

_____mm
MAN FISH

would be rendered in English as "The man is fishing with relaxation and enjoyment." Similarly, the ASL sentence:

_____mm
ENGINE RUN

would be best translated as "the engine is running smoothly".

Another nonmanual adverb used in ASL is "th" which carries the meaning of lack of control, inattention, carelessness and unawareness (see Liddell, 1980; and McIntire and Reilly, 1988). For this adverb, the head is tilted back and the tongue protrudes through

the lips at the side of the mouth, and the lips are pushed outwards slightly (see Figure 2.5). For instance, the ASL sentence:

_____th
MAN DRIVE

suggests that the man is driving in a careless manner. Both the "mm" and the "th" nonmanual adverbs were used by the deaf informants in our study, and were used with comparable SASL verbs. Figure 2.5 illustrates an example of usage of each adverb in SASL, with the same verbs as in the ASL sentences above.

(A) ____mm
FISH
"fishing with relaxation and enjoyment"

(B) _____th
DRIVE
"driving in a careless manner"

Figure 2.5 Illustration of two nonmanual adverbs in SASL

2.3.3 Nonmanual Signals with Lexical Scope

While nonmanual behaviours play a major role in the syntax of sign languages they also have some function within the vocabulary (see Liddell, 1980, and McIntire and Reilly, 1988, for a review of ASL and Brennan, 1992, for a review of BSL). Brennan (1992) notes that nonmanual signals occur particularly in multi-channel signs, but also as separate meaningful units which can be added to signs (nonmanual morphemes) and more rarely as individual signs in their own right. An extensive use of multi-channel signs was noted in our data and hence it was within multi-channel signs that our analysis of the function of nonmanual signals with lexical scope was focused.

In the past, controversy arose with regard to the terminology used to describe and define this group of signs. Many of the multi-channel signs were regarded as idioms. However

Bergman (1979, in Lawson, 1983) and others have suggested that the term "idiom" has been incorrectly used, as not all the multi-channel signs represent idiomatic expressions. Instead it was felt that the term multi-channel, as suggested by Baker (1980, in Lawson, 1983), was the more appropriate term, as it encompasses both those signs with idioms and those without. In Swedish Sign Language, these signs are referred to as "deaf signs" (Lawson, 1983). Many native South African signers call these signs "slang". Multi-channel signs are used frequently by native signers. However they are not easily understood or used by hearing people who do not have native sign competence (Lawson, 1983). In addition Lawson (1983) notes that these signs are usually not included in dictionaries or manuals of BSL. Multi-channel signs can rarely be represented by single words in English; rather they are translated into phrases or complete sentences. There are no sign-for-word equivalents.

Brennan (1992) notes that the distinguishing aspect of multi-channel signs is that there are compulsory nonmanual components which are inherent parts of the sign. Lexical items may be distinguished from one another purely on the basis of nonmanual features. They may be complex in terms of both their formational and linguistic functions. For a more detailed analysis regarding the use of multi-channel signs in SASL see Douglas (1993).

From these preliminary research findings on nonmanual behaviours in SASL, it appears that the function of nonmanual signals is the same as that found in other natural sign languages. This leads us to presuppose that nonmanuals which form part of the linguistic structure of sign languages may be considered as universal primary characteristics found throughout all sign languages.

2.4 RELATED NOUN AND VERB PAIRS

In ASL, there is a consistent, formal relationship between verbs and the deverbal nouns that are derived from them (e.g., "scissors/cut", "car/drive", "chair/sit") (Supalla and Newport, 1978; Bellugi, 1988). Such noun/verb pairs, which are also found in SASL, are characterised by two features identified by Supalla and Newport (1978). Firstly, the verb and the noun are related in meaning, and secondly, they are related formationally

(that is, they share the same handshape, palm orientation, place of articulation and general type of movement). The distinction between the noun and the verb is generally indicated in ASL by directionality, reduplication/repetition, and manner of movement (Supalla and Newport, 1978; Humphries, Padden and O'Rourke, 1980, p.90; Humphries and Padden, 1992, p.53), and the results of our study suggest that the same is true in the case of SASL. In our sample, some twenty-two noun/verb pairs were identified in SASL. An interesting feature of the twenty-two noun/verb pairs that were identified in SASL is that with only one exception (song/sing), the signs represented were iconic in nature (see Baker and Cokely, 1980, pp. 37-40; Deuchar, 1984; Pizzuto, 1985). This may indicate that operability may be an explanatory factor for the derivation of deverbal nouns, and this is certainly an area in which further research is needed.

2.5 SASL AS A DISTINCT LANGUAGE

The preliminary findings from this study confirm a number of important claims about SASL. Firstly the evidence indicates that SASL is a distinct language in its own right. It is not a derivational or pidgin language. It is rule-governed, grammatical, systematic, and similar in nature to other natural sign languages. Secondly, the evidence for the distinctive nature of SASL provides abundant documentation for the robustness of this language, which is particularly significant considering the historical oppression of deaf people and their language in South Africa and elsewhere (Grosjean, 1980; Lane, 1992; Penn and Reagan, 1990; Woodward, 1982). The evidence from this study not only provides us with a greater understanding of SASL syntax and morphology but contributes to the growing body of international literature which suggests that signed language may have universal characteristics (see also Coulter, 1990; Fromkin, 1978; Lillo-Martin, 1992; Meier, 1990).

The South African Sign Language Research Programme, which was conducted under the joint auspices of the Human Sciences Research Council and the National Council for the Deaf, has highlighted extensive lexical diversity in South Africa, reflective of the general diversity of the population (see Penn, 1992; Penn and Ogilvy, 1988; Penn et al, 1991; also of interest in this regard are Aron, Lewis and Willemse, 1986; Penn, Lewis and Greenstein, 1984; Warren, Meyer and Tesner, 1986). This lexical diversity, however,

pales in significance when one considers the relative homogeneity of the underlying syntax of SASL, for which considerable evidence from other population groups is now being collected (see Landman, 1990; Landman et al, in preparation; Penn et al, 1991). Should the data currently being collected and analysed continue to indicate the relative syntactic unity of SASL, the implications for a more unified approach towards the assessment and education of the deaf would be made possible. In addition, methods which have been developed in other countries to assess and teach language to the deaf child may well have immediate and direct local application.

CHAPTER THREE

LEARNING DISABILITIES IN HEARING AND DEAF POPULATIONS

In this chapter a discussion concerning learning disabilities within both the hearing and the deaf population groups is undertaken. The discussion focuses on aspects such as the definition and incidence of learning disabilities in general, the identification and characteristics of learning disabled deaf persons and the continuum of language disorders over time. Issues concerning cognitive processing, narrative skills, and memory, which are considered to be essential aspects in the assessment, identification and description of the characteristics of the learning disabled person, are discussed. The cognitive processing capacities of the deaf are also discussed, as this has direct implications for the identification of the learning disabled deaf individual.

3.1 DEFINITION

To date there is little agreement as to what constitutes an in-depth definition of "learning disabled" (Kavale and Forness, 1985). The term "learning disabilities" was first introduced in 1963. Since that time there has been no consensus on any single definition and the concept has remained an enigma (Lerner, 1985, in Hurwitz, 1993). The most widely used definition of "specific learning disabilities" is the one incorporated into United States Public Law (PL 94-142, 1975, cited by Wiig and Semel, 1984, p.17):

> Children with specific learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or using spoken or written language. These may be manifested in writing, spelling, or arithmetic. They include conditions which have been referred to as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia, etc. They do not include learning problems which are due primarily to visual, hearing or motor handicaps, to mental retardation, to emotional disturbances, or to environmental disadvantage.

Wiig and Semel (1984) claim that the above-mentioned definition is nonoperational and therefore difficult to implement. However Johnson and Morasky, 1977 (in Wiig and

Semel, 1984) note that special educators appear to agree on some inherent aspects of the definition. They are as follows:

1) One or more significant delays or deficits in essential learning processes (perception, integration, and verbal or nonverbal expression) must be present and require special education procedures for intervention or remediation.
2) The significance of a delay or deficit in the essential learning processes must be ascertained by accepted diagnostic procedures in education, special education, and psychology.
3) The presence of a delay or deficit in essential learning processes should be illustrated in a discrepancy between expected achievement, based on intellectual capacity, and actual achievement in one or more areas such as spoken, read, or written language, mathematics and spatial orientation.

In 1981 the National Joint Committee for Learning Disabilities (NJCLD) challenged the definition of learning disabilities in PL 94-142 and proposed the following definition (Hammill, Leigh, McNutt and Larsen, 1981, pp.339-340, cited by Bunch and Melnyk, 1989, p.298):

> Learning disabilities is a generic term that refers to a heterogenous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking and writing, reasoning and mathematical abilities. These disorders are intrinsic to the individual and presumed to be due to central nervous system dysfunction. Even though a learning disability may occur concomitantly with other handicapping conditions (e.g. sensory impairments, mental retardation, social and emotional disturbances) or environmental influences (e.g. cultural differences, inappropriate instruction, or psychogenic factors) it is not the direct result of those conditions or influences.

It is believed that for the purpose of the identification of the learning disabled deaf the definition proposed by the National Joint Committee for Learning Disabilities (NJCLD) is more appropriate than the definition of learning disabilities in PL 94-142. For the present study the definition proposed by the NJCLD was adopted. This choice was made for the following reasons, which are related to some of the core aspects of the study.

As has been noted by Wiig and Semel (1984) and Bunch and Melnyk (1989) the definition in PL 94-142 is frequently misinterpreted to refer to a homogenous rather than a heterogenous group of individuals. Secondly the definition only applies to individuals between birth and 21 years, which in itself fails to recognise that a learning disability may continue into adulthood. Finally it provides an "exclusion clause" that may be misinterpreted to imply that learning disabled individuals may not show multiple handicapping conditions or come from minority culture or language backgrounds.

3.2 THE INCIDENCE OF LEARNING DISABILITIES WITHIN THE DEAF AND HEARING POPULATION GROUPS

The percentage of hearing impaired students classified as "deaf learning disabled" forms the largest of the categories of multihandicapped hearing impaired students listed in the Tabular Summary of Schools and Classes in the United States (Craig and Craig, 1985). Currently 5%-7% of hearing impaired students in programmes for the hearing impaired are classified as "deaf learning disabled" (Craig and Craig, 1985).

The figure of 3% is most frequently cited when referring to learning disabled hearing school-aged children. Funderburg (1982) and Vernon (1982) (both cited in Powers et al, 1987) claim that the greater percentage of learning disabled in the hearing impaired population as compared with the hearing population may be due to etiological factors. However within both the hearing and deaf populations, accurate incidence figures of learning disabled students may only be obtained when there is a commonly accepted operational definition of learning disabled (Wiig and Semel, 1984; Powers et al, 1987).

A second aspect in obtaining valid estimates of the prevalence of any disorder is the criteria for inclusion and the evaluation procedures used. Hence the evaluation procedures used with the learning disabled student will have to improve in both reliability and validity for more valid estimates of prevalence to be obtained (Wiig and Semel, 1984). However, as noted by Bunch and Melnyk (1989), despite this imprecision with regard to incidence, there is evidence that professional educators believe that a learning disabled

hearing impaired group exists and that a significant proportion of the hearing impaired population falls within this group.

3.3 IDENTIFICATION OF THE LEARNING DISABLED DEAF INDIVIDUAL

Numerous difficulties are encountered when attempting to identify the learning disabled deaf person. Some of these difficulties are discussed in this section.

The absence of a precise definition of "learning disabled" and "learning disabled deaf" is one of numerous factors which complicate the identification of learning disabled deaf individuals (Jaussi, 1985, and Powers et al, 1987, both cited in Powers et al, 1988). Furthermore the emphasis placed on the difficulties with the processes involved in the receptive and expressive use of language within the various definitions of learning disabilities confounds the identification of the language impaired learning disabled deaf person. As Elliot et al (1988) and Powers et al (1987, in Powers et al, 1988) note, many students believed to be learning disabled hearing impaired have difficulties and inconsistencies in their receptive and expressive language abilities, but these difficulties need to be clarified with regard to this group due to the pervasive language deficits of many hearing impaired individuals. In addition, Powers et al (1988) claim that the specific nature of the inconsistencies found in the language processes of the learning disabled hearing impaired is not well understood.

As noted previously, Wiig and Semel (1984) and others have noted that another factor used to identify learning disabled students is when a discrepancy exists between expected achievement based on intellectual achievement and actual achievement in one or more areas such as spoken or written language, reading, mathematics and spatial orientation. Powers et al (1987) note that previous research suggests that this discrepancy has been used by educators of hearing impaired students in an attempt to identify learning disabled hearing impaired students. However, as noted by Powers et al (1988), there are tremendous problems with attempting to quantify achievement and potential. For example, if students' achievement scores are compared with grade placement, many hearing impaired students would be classified as learning disabled deaf. In addition

Powers et al (1988) claim that the difficulties involved in obtaining an accurate assessment of the intellectual capacity of hearing impaired individuals further complicate this issue. Similarly, Braden (1989) claims that nonverbal IQ : achievement correlations are so low that they raise the question of whether the WISC-R Performance Scale, which is the intelligence test used most often by psychologists assessing deaf children, or assorted nonverbal IQ tests, are appropriate for psychoeducational use with deaf children. The evidence from research undertaken by Braden (1989) suggests that the WISC-R Performance scale and a mix of nonverbal intelligence instruments fail to predict deaf children's achievement levels. Braden (1989) proposes that criterion-related validity studies with large samples and substantial results are needed before psychologists can predict deaf children's academic achievement (or other criteria) from nonverbal IQs.

The importance of using accepted diagnostic procedures in identifying delays or deficits in learning processes has been highlighted by special educators. However there is considerable variety relative to appropriate assessment for students who may be learning disabled as well as hearing impaired (Powers et al, 1987). Plapinger and Sikora (1990) also note that unfortunately normative performances for hearing impaired students have not been established for many commonly used instruments. The variety of assessment procedures and lack of appropriate standardised assessment tools have adversely affected the identification of the learning disabled deaf individual. As mentioned previously, the test instruments used to determine the intellectual capacity of deaf individuals in general and their use in predicting achievement and other criteria have been seriously questioned.

Likewise in the area of language assessment of the deaf and the learning disabled deaf there appears to be much confusion and controversy. Firstly, as mentioned in Chapter One, many deaf students are treated as monolinguals in English and their linguistic abilities are only assessed by means of "English tests". It is believed that a thorough assessment of deaf students' linguistic abilities would entail an assessment of sign language and spoken/written English. However there appears to be a serious lack of assessment tools to assess sign language skills. It is felt that comprehensive sign language batteries administered by native deaf signers and analysed by deaf signers in conjunction with language pathologists are necessary in order to determine the sign language abilities

of deaf individuals. Only then will we obtain a true reflection of deaf persons' linguistic ability. In determining both the intellectual capacity and the linguistic abilities of the deaf, validity of the assessments (e.g. local norms) should be maintained. Furthermore, additional research is required to determine the relationship between language abilities and learning disabilities in the deaf. It is also believed that in future research there should be greater control for factors such as: degree of deafness, hearing status of parents and family members, mode of communication used at home and in the education setting, and age of acquisition of sign language and spoken language.

In the past the most common method of identifying learning disabled deaf students has been "teacher observation" (Elliot, 1988, in Plapinger and Sikora, 1990). Teachers have the most frequent contact with students and they are able to make subjective comparisons based on their expertise and their knowledge of the academic achievement of the typical hearing impaired student. However the potential for misdiagnosis and the need for objective criteria and standardised assessment preclude the use of teachers as the sole identifying agent (Elliot et al, 1988, in Plapinger and Sikora, 1990). Teacher observation provides general information on the child's academic and behavioural functioning, whereas standardised assessment provides diagnostic information on the specific nature of a disability (Elliot et al, 1988).

3.4 CHARACTERISTICS OF THE LEARNING DISABLED DEAF

To date there are few relevant studies and a paucity of literature regarding the learning disabled deaf population. However, as mentioned in Chapter One, several national surveys in the United States of America have been conducted to promote a better understanding of the characteristics of the learning disabled deaf individual. Some of these characteristics appear similar to those of the learning disabled in general (Powers, Elliot and Funderburg, 1987, in Powers et al, 1988). The results from Powers et al's 1988 study suggests that although there are many unanswered questions about the identification of the learning disabled hearing impaired, there are some characteristics which appear to typify this group. These include poor language functioning, discrepancy between expected and actual achievement, behaviour problems, attention difficulties,

deficits in organisational skills and difficulty in retaining information. Obviously not all the characteristics were observed as typical of every learning disabled hearing impaired student; rather they appear to show varying behaviours that represent their individual learning disabilities.

In summary, as noted by Jaussi (1985) and Powers et al (1987) (both cited in Powers et al, 1988) considerable confusion still exists in defining, identifying, evaluating and programming for students who have been classified as learning disabled hearing impaired. Furthermore, to the writer's best knowledge, to date no formal systematic research has been undertaken in which the particular subgroup of language impaired learning disabled deaf persons has been identified.

3.5 THE RELATIONSHIP BETWEEN LANGUAGE AND LEARNING DISABILITIES: HOW SYMPTOMS OF EARLY LANGUAGE DISABILITY CHANGE OVER TIME

Of all the problems experienced by children with learning disabilities, difficulty with language may be the most pervasive (Wiig and Semel, 1984). The prevalence of language disorders within the learning disabled hearing population has been well documented (Johnson and Mykelbust, 1967; Berry, 1969; Kirk et al, 1968; Wiig and Semel, 1976; Benton and Pearl, 1978; Gerber and Bryen, 1981, all cited in Wallach and Liebergott, 1984). McKinney (1984, in Crais and Chapman, 1987) claims that although the learning disabled population is a heterogenous one with a number of subgroups the language impaired subgroup is the largest. "Language-conceptual" orientations in the 1970s and 1980s have helped us re-evaluate "perceptual deficit" orientations in learning disabilities that were more predominant in the 1960s than they are now (Wallach and Liebergott, 1984).

Wallach and Liebergott (1984), Merrit and Liles (1987), and Purcell and Liles (1992) note that still little is known about the continuum of language failure. However, results from follow-up studies of hearing children who present with language disorders early in life show that even after intervention, language disorders persist throughout the school

years and even through adulthood (Hall and Tomblin, 1978; Weiss et al, 1979; Snyder, 1980, in Wallach and Liebergott, 1984; Wiig et al, 1977).

The question of how overt symptoms of a language disability change over time is still unclear. However Wallach and Liebergott (1984) have summarised some of the ways that symptoms of early language disability change over time:

- Overt symptoms frequently seen in younger children with language disorders (e.g. reduced mean length of utterance, limited vocabulary, etc.) may become more subtle (e.g. they show up as inferential processing problems, word retrieval problems, pragmatic difficulties, etc.)
- Language problems may show up in reading and spelling, i.e. spoken language problems turn into written language problems.
- Verbal language problems may persist and in addition are evidenced in reading and writing.

To date, no formal studies have reported the sign language impairments found in the learning disabled deaf older child or adult. It is speculated that in this study some of the more subtle linguistic impairments noted above will be found in the signing of adult learning disabled deaf subjects.

The connection between language proficiency and school success is frequently noted in the literature. Further exploration into the linguistic proficiency of the hearing impaired individual will provide us with more information concerning the relationship between language, learning disabilities and school success. This in turn would provide us with more effective remediation programmes.

3.6 NARRATIVE DISCOURSE WITHIN THE HEARING LANGUAGE IMPAIRED LEARNING DISABLED GROUP

As mentioned in Chapter One, shifts in the investigation of the use of language have occurred recently with the focus of the assessment going beyond the single word and sentence level to include discourse. Narrative discourse tasks appear to be particularly

sensitive instruments for tapping higher level language and cognitive skills (Paul and Smith, 1993). It is within the narrative that more subtle linguistic deficits found in adult language impaired groups are frequently tapped. Discourse analysis in sign language is a recent development and most of the research to date has concentrated on aspects of the structure of conversation and the exchange of talk (Baker, 1976, 1977; Baker and Padden, 1978; Wilbur and Pettito, 1983, cited by Roy, 1989). These studies have generally focused on macrofeatures of turn taking, linguistic functions of nonmanual behaviours, and utterance boundaries and topic flow (Roy, 1989). No literature pertaining to the performance of learning disabled deaf subjects on signed discourse tasks could be located. Recently, however, investigations into the narrative skills of the learning disabled hearing population have been reported and some of these findings will now be discussed. An attempt to compare some of these findings with the findings from this research will be made in Chapter Five.

Learning disabled children have been reported to demonstrate problems in discourse forms that either supersede linguistic deficits or occur in the absence of structural language problems (Roth and Spekman, 1986). The discourse productions of learning disabled persons have been analysed using developmental models and story grammar approaches (Merrit and Liles, 1987). Using developmental models, various authors have suggested that when relating personal experiences and stories, learning disabled adults and children demonstrate problems of formulation and organisation (Blalock, 1982; Johnson and Mykelbust, 1967; McNamee and Harris-Schmidt, 1985; Westby, 1982, 1984; and Wiig and Semel, 1976, 1980, cited by Roth and Spekman, 1986). Empirical information concerning the narrative development of learning disabled children is scarce (Roth and Spekman, 1986). Westby (1984) proposes that the deficient narratives produced by learning disabled children may be due to inefficient processing, impaired organisational abilities, or insufficient schema knowledge. Blalock (1982, in Roth and Spekman, 1986) suggests that organisational difficulties of learning disabled persons may persist into adulthood.

In contrast to the developmental stage approaches mentioned above, a variety of story grammars have been proposed in which elements common to stories are identified and

formal sets of rules underlying the construction of stories are specified (Labov, 1972; and Mandler and Johnson, 1977, Rummelhart, 1975, Stein and Glen, 1979, and Thorndyke, 1977, cited by Roth and Spekman, 1986). The story grammar approach proposed by Labov was used in this study. As noted by Roth and Spekman (1986), although some differences do exist between the various story grammars, they are all similar regarding the components they contain and the order in which they occur. Although in general there is a fair amount of agreement among the studies using story grammars that learning disabled persons have knowledge of narrative structure and can apply this knowledge in their recall of stories, there appear to be contradictory findings regarding the amount of information recalled or included in their narrative productions. Several studies have shown that less information is recalled in the retelling of stories by language disabled than by unimpaired individuals (Feagans and Short, 1984; Merrit and Liles, 1987; Liles, 1985; Graybeal, 1981; Hansen, 1978; Weaver and Dickinson, 1982; Worden, Malmgren and Gabourie, 1982); others have found that the learning disabled did as well as the nondisabled on the amount of information recalled (Ripich and Griffith, 1988; MacLachlan and Chapman, 1988). As has been suggested by Roth and Spekman (1986), these discrepant findings may be partly explained by methodological differences between studies. Ripich and Griffith (1988) proposed that there may have been differences in the mode of stimuli presentation. However discrepant findings have also been reported within specific modes of stimuli. Ripich and Griffith (1988) report that learning disabled children did as well as nondisabled children on the amount they recalled and the amount they included in the self generated stories, whereas Merrit and Liles (1987) report that language disordered children talked less when retelling a story than unimpaired children but not in story generation, and Roth and Spekman (1986) found that when generating a novel story the learning disabled subjects produced stories that were significantly shorter.

Most of the research to date on the narrative skills in the learning disabled population appears to have concentrated on the coherence of their productions. Researchers have only recently begun to examine narrative cohesion in stories of language disordered children (Ripich and Griffith, 1988). In general, studies have reported that less cohesive narratives are produced by learning disabled language impaired persons than by

nondisabled persons, with differences centering around the use of pronouns as referents and conjunctions as ties among elements. More particularly, some of the findings have shown less explicit use of referencing in pronouns (Berger and Sinoff, 1978), fewer personal referencing ties (Liles, 1985), the extensive use of personal referencing without establishing the referent either cataphorically or anaphorically, and a greater extent of use in ambiguous contexts (Norris and Brunning, 1988). Strong and Shaver (1991) note that a review of the literature reveals conflicting findings and findings of no difference between means for cohesive density and types of cohesive ties among normally developing, language impaired and learning disabled school-aged children. They have suggested that in studies where no difference was found between means for types of cohesive ties and cohesive density, this may have been due to unreliability of scores. Strong and Shaver (1991) have called for stricter measures of reliability to be used in studies of this nature. They have recommended the use of reliability measures, including intra-coder agreement, internal consistency of responses, and stability of scores across testing sessions, before any reliability and generalisability of results can be confirmed.

3.7 COGNITIVE PROCESSING IN THE DEAF

It is believed that a discussion concerning the cognitive processing capacities of the deaf is essential when discussing the learning disabled deaf population, for the following reason. There has been much debate and controversy concerning the intellectual potential of the deaf, which in turn has a direct effect on the identification of the learning disabled deaf population. Knowledge concerning the intellectual potential of the deaf is necessary, as an inherent aspect of the definitions of learning disabilities is the presence of a discrepancy between expected achievement, based on intellectual capacity, and actual achievement in one or more areas such as language, mathematics and spatial orientation. Furthermore, it has been well documented that academic achievement levels for most hearing impaired students fall below those of their normally hearing peers.

Although more recently a majority of studies investigating intellectual potential "have found no difference between hearing and deaf children" (Moores, 1982, p.148, cited by Bunch and Melnyk, 1989) there has been a long history of the deaf being viewed as

intellectually inferior when compared with hearing persons. In a recent overview of research into the cognitive capacities of the deaf population, Quigley and Paul (1984) and Moores (1978, in Wood, 1991) have identified three dominant perspectives in the history of this field.

The first view held that deaf people lack intelligible language and therefore their intellectual capacities fall far below that of hearing people (Wood, 1991). However this view lacked empirical support and gave way to the view put forward by Mykelbust (1964, in Wood, 1991). Mykelbust concluded that the cognitive abilities of deaf people are more concrete and less abstract than hearing people. Furth (1966, in Wood, 1991, and in Parasnis, 1983) subsequently rejected this theory and suggested that the reason for the deaf child's delay in achieving success compared to their hearing counterparts may be due to an "experiential deficit", that is, a lack of experience of the world as a result of the language impairment associated with auditory impairment. However Parasnis (1983) notes that it is not certain that an auditory impairment is essentially associated with a general language impairment, and moreover that Furth has not defined the construct of experiential deficiency nor have criteria been established to assess it. Parasnis (1983) therefore claims that Furth's hypothesis has limited predictive power in determining performance on specific perceptual or cognitive tasks. Wood (1991) further suggests that it seems possible that deaf children experience developmental and educational delays not because they lack a language of thought but because hearing people find it more difficult to pass on their knowledge, skill and understanding because of problems in communication. Wood (1991) claims that one of the main problems found in hearing people's communication with hearing impaired children, whether it is conducted in speech, sign-supported English or signed English, is "too much control". Short-term effects of high control have been identified in some detail: low child initiative; short utterances; and the child seldom being exposed to communication involving speculation, hypothesis formulation, imagination or negotiation (Wood, 1991). In these communicative situations children are provided with a poor linguistic input and little space to develop flexibility, creativity and self expression. Long-term effects of high control in hearing children are: passive behaviour, low motivation, and poor self-regulation in learning and problem solving. Wood (1991) claims that disrupted

communication and adult control may help explain deaf children's so called "experiential deficit" or cognitive delays. He believes that there are a number of practical and educational implications that follow this argument, one being that the study of deafness and its effects on learning and cognition cannot proceed simply by testing the child but that the practices used by the hearing educators should rather be considered. Although Wood (1991) is not referring to sign language, but to spoken and signed English, it would seem likely that chronic high control would not exist in a signed communicative interaction in which profoundly deaf children who use sign language as their primary means of communication were involved and that then these linguistic deficits would not prevail.

Historically, non-verbal tests, including visual perceptual tests, have been used to determine the intellectual skills of hearing impaired people (Parasnis, 1983). It is generally accepted both by researchers and educators that hearing impaired children do not differ from hearing children when quantitative measurements of non-verbal IQ are employed (Parasnis, 1983). However Parasnis notes that this research has provided an inspiration for researchers to study specific perceptual and cognitive skills in hearing impaired people.

Parasnis's (1983) review of the research that has used visual perceptual tests to make inferences about the cognitive and linguistic skills of hearing impaired people shows that many of these studies have overinterpreted and overgeneralised their findings when making conclusions pertaining to the cognitive and language skills of the hearing impaired. In addition, in these studies language has commonly been defined in operational terms, such as reading or speech reading skills. Parasnis (1983) also questions whether hearing impaired people have a "general language" impairment. If manually coded English or sign language is acquired early in life it is quite possible that normal language development ensues and therefore it should not be assumed that the normal development of thought processes has been influenced. Furthermore, the link between "language" deficiency and deafness has not been adequately defined (Parasnis, 1983). In summary, Parasnis notes that visual perceptual tests used to make inferences about the cognitive functioning of hearing impaired people have not supported any of the previously

mentioned hypotheses. Rather the results from more recent studies have shown that when linguistic and perceptual abilities are controlled for, deaf subjects exhibit visual perceptual skills and abilities equivalent to that of hearing subjects (Marlowe, 1991). However it has been suggested that hearing impaired people may develop and use different perceptual strategies, which may account for the different performances found on the perceptual tests between hearing impaired and hearing people (Parasnis, 1983). In support of this claim, Clark (1991) states that deaf and hearing people do indeed process information differently, and by using more ipsative analyses greater understanding of the full complexity of a person's information processing strategies may be determined.

3.8 MEMORY PROCESSES

A discussion concerning the particular cognitive process of memory was thought to be necessary for the following two reasons. Firstly, assessment of memory and its relationship with language forms a central part of this study. "The relationship between memory and language appears to be reciprocal in that memory is acknowledged to play a critical role in language and language has been demonstrated to be a potential facilitator of memory" (Gerber, 1981, p.83, cited by Klein Koningsberg, 1984, p.264). Secondly, not only are language deficits commonly identified among the learning disabled but so is memory a frequent source of difficulty for learning disabled individuals. Hence memory forms an integral part of investigations regarding learning disabled individuals.

Unfortunately no systematic studies on memory within the learning disabled deaf population, apart from that conducted by Marlowe (1991) on the serial recall of nonlinguistic information, have been reported. Hence this discussion will focus on the memory processes of the nondisabled deaf population and the memory processes of the learning disabled hearing population.

3.8.1 Memory Processes in the Nondisabled Deaf Population

Most of the research on memory of the deaf has concentrated on how the deaf encode signed and printed stimuli. Although only a few studies of memory in sign language have

been conducted, they indicate that the strategies adopted by deaf subjects are very similar to those used by hearing subjects in oral languages (Grosjean, 1980; Frumkin and Anisfeld, 1977). Deaf people have been shown to encode signed stimuli in the visual-kinaesthetic code during short-term memory tasks (Bellugi, Klima and Siple, 1979). Results from studies conducted by Bellugi et al (1975), Bellugi and Siple (1974), Poizner, Bellugi and Tweney (1979) (all in Grosjean, 1980) have shown that deaf signers code signs in short-term memory in terms of linguistically significant formational parameters. The semantic and iconic information of signs, however, seems to have little effect on short-term memory. Siple, Fischer and Bellugi (1977, in Grosjean, 1980) conducted a study in an attempt to answer the question of whether signs are stored in short-term memory according to their formational parameters or in long-term memory according to semantic traits (as for words). Their results indicate that the signed items are stored in long-term memory in the same way as the lexical items from English, specifically according to their semantic traits. Although the formational parameters of a sign play an important role in short-term memory they do not appear to be involved in the storage in long-term memory.

Chalifoux (1991) notes that before conclusions can be made regarding the encoding strategies and abilities of the deaf, it is necessary to comment on factors such as attentional resources and memory capacity. If the deaf have attentional deficits, then difficulties in memory may also be expected due to an inability to attend to stimuli. However research (Parasnis and Samar, 1985, and Dittmar, Berch and Warm, 1982, both cited in Chalifoux, 1991) has shown that, with respect to visual stimuli and sustained visual attention, the deaf are equal to or even superior to the hearing, perhaps due to a lack of distraction from auditory input or to a superior ability to deal with visual information. The memory capacity of the deaf may be somewhat shortened due to the nature of encoding in short-term (working) memory (Chalifoux, 1991). Regarding the memory span for signs used in sign languages very little is known (Hoemann and Blama, 1992). However Bellugi et al (1979) reported that college students who were deaf children of deaf parents recalled an average of 4,9 signs presented via videotape at the rate of one sign per second with list interpretation, as compared to hearing college students who recalled an average of 5,9 English words presented similarly. They reported this

difference as statistically significant and explained the difference between memory span for signs and words on the basis of the amount of time required to execute a sign or speak a word. When lists of signs and words are presented at the same rate, less time is available for rehearsing the signs, because signs take more time to execute. The longer rates for overt and covert signing would result in fewer items being rehearsed during a set period with fewer items encoded and consequently retrieved from the working memory (Chalifoux, 1991).

There is considerable disagreement about how deaf signers encode printed material (Akamatsu and Fischer, 1991). Odom, Blanton and McIntyre (1970, in Akamatsu and Fischer, 1991) found that deaf teenagers learned new English words more easily if they were "signable", suggesting that a sign-based code is used in short-term memory. However Frumkin and Anisfeld (1977) claim that printed words are encoded along both orthographic and semantic dimensions.

Some of the more recent work conducted by researchers examining the information processing capabilities of deaf people has focused on the types of memory processing strategies generated by deaf individuals and the effectiveness of those strategies in aiding recall (Bebko, Lacasse, Turk and Oyen, 1992). The results from this work have indicated that deaf children perform less well than hearing children on tasks that are biased towards verbal or sequential processing (Bebko, 1984; Bebko and McKinnon, 1990; Belmont, Karchmer and Pilkonis, 1976; Hanson, 1982; Krakow and Hanson, 1985; Stuckless and Pollard, 1977; Wallace and Corballis, 1973, all cited in Bebko et al, 1992), yet they perform as well as or better than hearing children on tasks that involve visual or spatial (simultaneous) processing (Blair, 1957; O'Conner and Hermelin, 1976; Withrow, 1968, in Bebko et al, 1992). The results from an examination of serial memory processing in the deaf conducted by Moore (1989, in Marlowe, 1991) revealed that deaf subjects did significantly more poorly than their hearing peers on tasks involving linguistic-sequential information but performed as well as or better on visuo-spatial sequencing tests. Marlowe (1991) noted that experimental differences are frequently a function of a variety of other factors, including the bias of the materials used, the linguistic content of the stimulus items and the manner of presentation. When these factors are controlled, no differences

appear between hearing and hearing impaired subjects on tests of short-term nonlinguistic sequential material.

Although all the above mentioned studies have indicated that the deaf perform more poorly than the hearing on memory tasks involving verbal or sequential processing and serial recall of linguistic material, it is proposed by the researcher that if signed material were presented by a deaf native adult signer these reported deficits might not be apparent. However Bebko et al (1992) note that encoding differences seem to underlie many of the results regarding memory to date and furthermore it is those tasks most amenable to spontaneous cumulative rehearsal strategies that have produced the greatest discrepancies between deaf and hearing children. The poorer performance of deaf children in the production of these strategies has been linked with age delays (Bebko, 1984, and Bebko and McKinnon, 1990, in Bebko et al, 1992). Bebko and McKinnon associated the emergence of spontaneous rehearsal strategies with the development of language proficiency in the child. They claim that the language skills of the deaf child account almost entirely for the relationship between age and the emergence of spontaneous rehearsal strategy, the cardinal argument being that not until the language skills of the child have been well automatised are they employed efficiently in rehearsal strategies. Bebko et al (1992) confirm the findings that deaf children tend not to use spontaneously active memory strategies such as rehearsal in tasks requiring recall of ordered, temporal information using a central-incidental paradigm, which differs from the classic serial recall paradigm, and thus confirm that this tendency is not task specific. In addition they note that the deaf compensated for their difficulties in mediating recall by capitalising on unique spatial features of the task; similar performance may therefore not have been the result of equal strategy use but rather of the use of additional strategies by the deaf students. Clearly further research is still needed regarding these additional strategies and especially within a learning disabled deaf population.

Little research has been conducted investigating the difficulties in memory experienced by learning disabled deaf persons. As has been mentioned, to the best of the author's knowledge no research has been conducted on the memory difficulties in sign among the learning disabled deaf population. The strategies adopted by the deaf in memorising sign

are very similar to those used by the hearing in oral languages (Grosjean, 1980; and Frumkin and Anisfeld, 1977). Hence some of the difficulties experienced by the learning disabled deaf should parallel those of the hearing learning disabled population. Although much future research is required regarding the memory processes of the deaf and the learning disabled population groups it was felt necessary that a brief discussion should follow regarding some of the difficulties in memory experienced by the hearing learning disabled and some of the difficulties experienced in investigating memory deficits in the learning disabled population.

3.8.2 Memory Processes in the Learning Disabled Hearing Population

As mentioned previously, memory is a frequent source of difficulty for learning disabled children and they perform poorly on various tests of memory (Friedes and Messina, 1986; Omrod and Lewis, 1985.) However, Maxwell et al (in Klein Koningsberg, 1984) state: "Indeed it would be an understatement to say that within language learning disability circles, characterisations of memory and memory disorders vary significantly". The differences in opinion regarding memory problems and their interaction with learning disabilities are due, in part at least, to the different theoretical and practical orientations of professionals involved in serving these children (Maxwell et al, in Klein Koningsberg, 1984).

In addition Fletcher (1985) notes that recent studies of memory in children with learning disabilities have produced a variety of ambiguous results. Some investigators have concluded that memory deficiencies reflect a fundamental difficulty encoding and storing material into short-term memory because of (a) problems with specific aspects of language such as phonology or (b) problems with encoding the order of items on serial recall tasks. Others have argued that memory problems reflect more general difficulties with control processes such as selective attention, organisation and retrieval. Deficits on memory tasks in these studies are interpreted at the level of transfer from short-term to long-term storage or in terms of retrieval from long-term storage. These investigators commonly implicate deficits in rehearsal strategies as a major factor in the memory performance of disabled learners (Fletcher, 1985).

Fletcher (1985) identifies three problems which have led to these ambiguous results. The first problem is that many of these studies have treated disabled learners as a homogeneous group, presumably with similar memory deficiencies. However recent research (Doehring, Trites, Patel and Fiedorowicz, 1981; Rourke, 1985; Satz and Morris, 1981, in Fletcher, 1985) note that subgroups of disabled learners may have different processing deficiencies. Hence subgroups of disabled learners may exist who vary in memory abilities. The second problem is that most investigators have used memory tasks that are primarily verbal in nature. When tasks employing verbal and nonverbal material have been employed, presentation formats have differed, so that the tasks have not been analogous. The use of analogous verbal and nonverbal memory tasks may help elucidate the nature of information processing deficiencies in disabled learner subgroups.

The third problem in current research is that memory tasks which permit separation of storage and retrieval skills have rarely been employed. Inferences concerning memory deficiencies have been based primarily on free list, recognition and serial recall tasks. Buschke (1973, 1974, in Fletcher, 1985) has argued that these types of tasks do not adequately separate storage and retrieval skills unless administered and scored with a selective or restricted reminding format. Selective reminding formats represent free list learning tasks that in subsequent presentations repeat only those items not recalled on the previous trial. Since selective reminding procedures separate storage and retrieval skills, these tasks can be used to address issues of storage versus retrieval deficiencies in disabled learners. An individual with poor storage and poor retrieval skills may be having difficulty encoding material into short-term recall; whilst adequate storage and poor retrieval scores would reflect a problem with retrieval. All the above-mentioned problems involved in the investigations of memory would also apply when examining memory performance in the deaf and should be considered in any future research.

3.9 CONCLUSION

In conclusion, there is an evident need for further research in the field of learning disabilities in the deaf population. There are clearly numerous difficulties in identifying and describing the characteristics of the learning disabled deaf person, which confounds

the problem when attempting to identify the language impaired learning disabled deaf individual. Although there are numerous tests to assess competency in English, the lack of assessment tools to investigate sign language skills in the deaf population has hindered identification of deaf individuals with a general language impairment. In addition it is evident that there is a need for further development of more appropriate tools to investigate cognitive skills in the deaf population. As mentioned previously, it is also suggested that in any future research greater control should be exercised for factors such as degree of deafness; age of onset of deafness; hearing status of family members; mode of communication used at home, socially and in the educational setting; and age of acquisition of spoken and signed languages.

CHAPTER FOUR
METHODOLOGY

This chapter presents the aims, methodological design, subject selection criteria and description of subjects used in this study. In addition the diagnostic test battery, methods of data collection and methods of analysis are described.

4.1 AIMS

The aims of this study were as follows:

a) to develop a South African Sign Language test battery, comprising a standard language battery, formal sign language tests and a narrative discourse task;

b) to investigate the receptive and expressive sign language abilities of three learning disabled deaf (LDD) subjects;

c) to examine related cognitive functions in LDD and nondis- deaf subjects so as to assist in the interpretation of the nature of the subjects' linguistic abilities and disabilities;

d) to determine a profile of each subject's linguistic and cognitive abilities and disabilities considering the complex and variable nature of individual disorders of learning; and

e) to attempt to identify linguistic and cognitive trends displayed by the LDD subjects, relative to each other and their matched controls.

4.2 RESEARCH DESIGN

As mentioned in Chapter One, a parallel case study design was employed in this study. This approach was selected as it has been argued that the only valid methodology for research with brain damaged patients is one based on single patient studies (Caramazza, 1986; Caramazza and McCloskey, 1988; Caramazza, 1991). Group studies involving averaging patients' performance is legitimate only where the homogeneity condition is satisfied, i.e. where it has been demonstrated empirically that the functional lesions in a group of patients are equivalent. The difficulties inherent in satisfying this condition of

homogeneity within the brain damaged population have been clearly documented (see Caramazza, 1986). The heterogenous nature of learning disabilities has been well recognised for the past twenty years (Hynd, Obrzut, Hayes and Becker, 1985). The variability in the subtype literature can be explained at least in part by an understanding of how widely distributed and interactive are the various functional systems in learning. It can be argued that each individual probably reflects a unique clinically derived subtype, depending on the individual pattern or distribution of neurodevelopmental deficits. Subtypes are formulated through grouped data thus obscuring individual profiles (Hynd et al, 1985).

In this research an attempt at determining the individuals' profiles rather than diagnosing the particular subtype of learning disability became the priority. Hence the parallel case study design was employed as it was considered the most appropriate method of research with the learning disabled deaf population, considering the heterogeneity of this population group and the danger of overlooking individual variations in group studies.

4.3 SUBJECTS

4.3.1 Sample Size

Three learning disabled deaf adult signers were assessed in this study.

Three deaf adults with no history of learning disabilities or any other neurological or behavioural disorders were also included in the study. These subjects were matched for age, degree of deafness and signing dialect. The inclusion of these nondisabled deaf adults permitted validation of the assessment tasks and results obtained.

4.3.2 Subject Selection Criteria

The following criteria were applied in the process of subject selection:

a) Subjects were required to have been congenitally or prelingually deaf with a maximum onset age of two years. As noted by Meadows (1980) the cut off age for the critical definition of prelingual deafness is often set at two years.

b) Degree of hearing loss: Subjects were required to have a bilateral profound hearing loss (i.e. greater than 90dbHL), since this population relies to a greater extent on sign language (Schlesinger and Namir 1978, Siple 1978).

c) Subjects should have attended a residential school for the deaf from an early age (3-4 years) and received their primary and secondary education at that school (the one exception is detailed below).

d) Subjects were required to have used sign language as their primary means of communication throughout their lives.

e) Subjects were required to be integral members of a deaf community. This has been defined by Markowitz and Woodward (1978, in Padden and Humphries, 1988) as having self-identification with a deaf community and having skills in the sign language used by that group. In this study the subjects were selected from the cohesive Johannesburg white deaf community. Initial interviews with the patient, his or her family and friends were conducted prior to selection in order to establish this criterion.

f) Age: Subjects were required to be above the age of 18 so as to ensure that sufficient integration with other deaf individuals and the Johannesburg adult deaf community had occurred, thus allowing for the acquisition of sign language and in particular the dialect used in Johannesburg. The effect of the number of years of sign language usage on the performance of certain signed linguistic tasks has been documented by Mayberry (1993). Mayberry and Fischer (1989, in Mayberry, 1993) found that the longer the signer had used sign language (from 2 to 20 years) the more accurately he or she performed on two kinds of sentence processing tasks.

g) Selection of learning disabled subjects was based solely on the identification of a learning disability made by teachers and other professionals during each subject's school career. This is the most widely used method of identification of such

subjects, given the numerous difficulties still encountered in identifying learning disabled deaf subjects, such as the lack of a clear definition of learning disabilities and the lack of appropriate assessment tools and procedures (see Chapter Three).

h) Intelligence quotient: An average to above average nonverbal IQ, as determined by a formal intellectual ability test, was required of all subjects. This criterion was included as, according to Wiig and Semel (1984), an inherent aspect of the US federal definition of learning disabilities agreed upon by special educators is the presence of a delay or deficit in essential learning processes, illustrated by a discrepancy between expected achievement according to intellectual capacity and actual achievement, in one or more areas such as language, mathematics and spatial orientation. Verbal IQs were not considered because verbal IQ test have been developed and are administered in a spoken language, which results in depressed scores for most hearing impaired students.

i) Handedness: Subjects were required to be right hand dominant. Developmental findings and evidence from research on hemispheric specialisation of sign language point to a left hemisphere lateralisation for sign language among right handers comparable to the situation in spoken language right handers (Vaid, Bellugi and Poizner, 1985). Right handers have verbal abilities in the contralateral left hemisphere and spatial abilities in the right hemisphere, whereas left handers tend to display a pattern of cerebral organisation that is either the same as the right-handed pattern or less well defined (Sheehan and Smith, 1986). Levy (in Sheehan and Smith, 1986) proposed that individuals with verbal abilities in both cerebral hemispheres and spatial abilities in the right hemisphere are inferior on visuospatial performance tasks to those with verbal abilities in the left hemisphere and spatial abilities in the right hemisphere. Hence, as the examination of verbal and visuospatial abilities was central to this study, only right handers were included in the sample.

4.3.3 Subject Consent

Consent with regard to the subjects' participation in the study was obtained prior to examination. The purpose of the study and the procedures to be undertaken were fully explained to the subjects and their families prior to their giving of consent. In addition permission was granted from the principal of St Vincent's School for the Deaf and from each subject for the perusal of all reports written during their school years.

4.3.4 Subject Description

Prior to administration of the test battery, an initial interview was conducted with each subject, in which information pertaining to the subject selection criteria was obtained. Information regarding medical, educational and vocational history as outlined in the original Boston Diagnostic Aphasia Examination (BDAE) Biographical Questionnaire was obtained. In addition to this information, other questions were put to the subjects pertaining to their hearing status, language background, mode of communication, acquisition of sign language and competence in signing. These questions were adopted from the "Language Background Questionnaire" which was employed in the national "Deaf Communication Project" (Penn, 1992). In addition, consultations were held with the staff from the school which all six subjects had attended. Perusal of all reports written by teachers, speech therapists, occupational therapists, psychologists and neurologists, pertaining to the subjects, was undertaken.

4.3.4.1 The learning disabled subjects

All biographical and clinical information for the three LDD subjects is presented in Table 4.1. The three LDD subjects and the three matched control subjects are referred to as LDD1, LDD2, LDD3 and C1, C2, C3 respectively.

Table 4.1: Case history details of the learning disabled subjects

	LDD1	LDD2	LDD3
Age	25 years	30 years	21 years
Sex	male	male	male
Age of onset of deafness	birth	birth	11 months (after contracting pneumococcal meningitis)
Degree and type of hearing loss	bilateral profound sensori-neural hearing loss	bilateral profound sensori-neural hearing loss	bilateral profound sensori-neural hearing loss
Primary mode of communication	South African sign language	South African sign language	South African sign language
Deaf community	Johannesburg deaf community	Johannesburg deaf community	Johannesburg deaf community
Schools attended	St Vincent's School for the Deaf, Johannesburg	St Vincent's School for the Deaf, Johannesburg	St Vincent's School for the Deaf, Johannesburg
Educational level	Standard 10	Standard 10	Standard 10
Amplification	none (no reported benefit from hearing aids)	none (no reported benefit from hearing aids)	none (no reported benefit from hearing aids)
Present occupation	motor mechanic	photographer	farmer
Significant medical history	- difficulty at birth, needed resuscitation - floppy baby - encephalitis at 7 mnths - three recurrent attacks of encephalitis	slight convulsions reported between the ages of 0 and 3 months - consciousness was never lost	- needed oxygen at birth - pneumococcal meningitis at 11 mnths - delayed milestones - possible epilepsy during childhood
EEG reports	an EEG completed at 10 years revealed a maturation defect in the fronto-temporal and fronto-central area indicating a potential problem with language	an EEG completed at 12 yrs revealed no abnormalities	- an EEG completed at 2 yrs indicated the possibility of a maturation defect of the fronto-central and fronto-temporal areas perhaps with maximal right hemisphere involvement - EEGs completed at 4 and 5 yrs showed no abnormal signs but epilepsy was not ruled out and subject was placed on carbamazepine (tegretol) - an EEG completed at 14 yrs indicated some fronto-cortical dysfunction
IQ - verbal **- nonverbal**	- below average range - high to average range (tested at 19 yrs 3 mnths)	- below average range - average range (tested at 15 yrs 9 mnths)	- below average range - high to average range (tested at 19 yrs 1 mnth)

	LDD1	LDD2	LDD3
Occupational therapy record	assessments completed by occupational therapists revealed adequate visual perceptual skills	occupational therapy before and during assessments revealed: - poor visuo-motor control - poor visual discrimination - poor visual memory - poor visual sequential memory	visual perceptual problems were reported
Speech therapy reports re spoken and written English	- limited receptive and expressive vocabulary span - comprehension difficulties - word order problems	- limited receptive and expressive vocabulary span - poor comprehension - poor sequencing skills	- poor receptive and expressive language ability - limited receptive and expressive vocabulary span - word finding difficulties - sequencing difficulties - poor comprehension
General education reports	- poor memory - poor attention and concentration - poor spelling - aphasic - attended remedial lessons	- poor attention - poor memory - poor arithmetic - poor spelling - received remedial lessons	- poor memory - fluctuating attention span - poor arithmetic - poor spelling - severe difficulties in reading - received remedial therapy

As can be seen in Table 4.1, all three LDD subjects presented with a profound bilateral sensori-neural hearing loss. They all attended the same school for the deaf, used sign language as a primary means of communication and were integral members of the Johannesburg deaf community.

LDD1 and LDD3's nonverbal IQs were reported to fall within the "high to average" range and that of LDD2 within the "average" range. Both LDD2 and LDD3 were reported to have visual perceptual difficulties, whilst LDD1 was reported to have adequate visual perceptual skills.

According to their teachers' (general education) reports, all three LDD subjects experienced difficulties with spelling, and had poor attention and concentration spans, and memory problems. Despite the latter, no comprehensive assessment of memory was undertaken. LDD2 and LDD3 were noted as having had difficulties with arithmetic and LDD3 severe difficulties with reading while at school.

Although the three subjects were all reported to have impaired language abilities, this had only been assessed in spoken and written English. The subjects' sign language abilities had not been assessed. Thus, from the assessments completed during their schooling years, it was not determined whether any of the LDD subjects had any impairments in sign language and therefore whether they had any general or central language deficit.

The three learning disabled subjects were all reported to have verbal IQs that fell within the "below average" range. These assessments had been administered in spoken English, by a hearing psychologist. Sometimes the spoken word was accompanied by the signed equivalent. It is believed that the results from verbal IQ tests are not a true reflection of deaf subjects' verbal ability. It is suggested that the use of more appropriate assessment tools, which assess subjects' verbal ability in sign, would provide us with a more accurate account of deaf subjects' verbal ability. In addition the findings from a study conducted by Marschark and West (1985) indicate that evaluating the linguistic and cognitive skills of deaf school children in terms of English underestimates their abstractive linguistic and cognitive abilities.

It is clear from a review of the reports of the three LDD subjects' past psychological and linguistic assessments that there is a serious lack of appropriate assessment tools. As discussed in Chapter Three, only when we have developed more appropriate and standardised assessment tools and procedures for use with the profoundly deaf will be able to identify learning disabilities and describe learning disabled deaf individuals' linguistic profiles more accurately.

4.3.4.2 The control subjects

A summary description of the biographical and clinical information for the control subjects is displayed in Table 4.2.

The control group consisted of three deaf adults with no reported history of learning disabilities or any other known neurological disorder. They were matched with the learning disabled subjects for age, degree of hearing loss, membership of the same deaf community, and use of sign language as a primary means of communication. Control

subjects C1, C2 and C3's ages were 25, 27 and 21 years respectively. C2 and C3 presented with a congenital bilateral profound sensori-neural hearing loss and do not wear hearing aids as a result of no benefit from amplification. C1 presented with a severe to profound hearing loss and benefits from amplification. C2 and C3 attended a school for the deaf, St Vincent's School for the Deaf, for their entire school career. C1 attended St Vincent's School for the Deaf and a hearing school. All control subjects are integral members of the Johannesburg deaf community. C2's spouse and one of her siblings are profoundly deaf. C1 has deaf parents and three deaf siblings. Although C1 differs from the other control subjects and the learning disabled deaf subjects with regard to degree of hearing loss, and hence schooling, he has used sign language as his primary means of communication throughout his life, being the son of deaf parents and brother of deaf siblings, and hence was considered a suitable control subject.

C1 and C2 were reported to present with high-average nonverbal IQs and C3 with an average nonverbal IQ. All control subjects were reported to have adequate visual perceptual skills. According to general educational reports no difficulties in any of the school subjects was noted.

Table 4.2: Case history details of the control subjects

	C1	C2	C3
Age	25 years	27 years	21 years
Degree and type of hearing loss	bilateral severe to profound sensori-neural hearing loss	bilateral profound sensori-neural hearing loss	bilateral profound sensori-neural hearing loss
Amplification	aided	none	none
Primary mode of communication	South African sign language	South African sign language	South African sign language
Deaf community	Johannesburg deaf community	Johannesburg deaf community	Johannesburg deaf community
Schools attended	- St Vincent's School for the Deaf, Johannesburg - King David High School, Johannesburg	St Vincent's School for the Deaf, Johannesburg	St Vincent's School for the Deaf, Johannesburg
Education level	Standard 10	Standard 10	Standard 10
Present occupation	computer programmer	computer programmer	computer programmer
IQ - verbal **- non verbal**	high-average high-average (tested at 16 yrs 2 mnths)	average high-average (tested at 15 yrs 8 mnths)	average average (tested at 17 yrs 7 mnths)
Occupational therapy record	- assessments completed by occupational therapists revealed adequate visual perceptual skills	- assessments completed by occupational therapists revealed adequate visual perceptual skills	- assessments completed by occupational therapists revealed adequate visual perceptual skills
Speech therapy reports re: spoken and written English	- good use of spoken and written English	- poor speech intelligibility - limited vocabulary span - needs sign language	- poor speech intelligibility - limited vocabulary span - needs sign language
General education reports	- copes well in all schools subjects	- no reported difficulties in school subjects	- no reported difficulties in school subjects

4.4 TEST CONSTRUCTION

In order to address the aims of this study, a test battery was designed which consisted of four main groups of tests: a battery of sign language tests based on the Boston Diagnostic Aphasia Examination, formal sign language tests, a signed narrative discourse task and a cognitive test protocol administered in sign language (see Table 4.3).

Table 4.3 The Four Main Groups of Tests used in this Study

STANDARD BATTERY OF LANGUAGE TESTS
FORMAL SIGN LANGUAGE TESTS
SIGNED NARRATIVE DISCOURSE PRODUCTION
COGNITIVE TEST PROTOCOL

Of these tests some only required translating into sign language, others required adapting and translating, others were derived from existing test guidelines and yet others required developing.

4.4.1 Principles underlying Test Construction and Adaptation

The following principles were applied during test construction and adaptation.

a) All adaptations, translations and construction of test material were carried out with the assistance of three deaf adult native signers, which was considered to be a fundamental component of this research. In addition, test administration, transcription of discourse data and scoring were undertaken by deaf native signers. They were all congenitally deaf with bilateral profound hearing losses, who used sign language as their primary means of communication and were integral members (as defined above) of the Johannesburg deaf community. Descriptive data pertaining to the deaf signers who assisted in this study are presented in Table 4.10 (see section 4.5, Data Collection).

b) Although there are numerous lexical variations found among different deaf communities in South Africa (Penn, Reagan and Ogilvy, 1990), for the purposes of this research tests were translated only into the dialect used by the Johannesburg deaf community.

c) Prior to any item being included in the tests, there was 100% agreement among the three deaf signers who assisted with the construction of the tests, with regard to the correct regional variation of the sign being employed. Results obtained from research recently undertaken under the auspices of the Human Sciences Research Council and the South African National Council for the Deaf, entitled the "Deaf Communication Project", indicated a strong cohesive Johannesburg sign dialect.

d) An attempt was made to include only one-handed signs in the expressive test items in the standard battery and formal sign language tests. Poizner et al (1987) noted that certain brain damaged patients may present with paralysis of either the left or right arm, and only be able to sign with one hand. Although the inclusion of only right-handed signs was not essential for this study, given the type of subjects studied, this suggestion was considered important in view of the potential for the use of this battery with other neurologically impaired deaf populations in the future. Hence all expressive test items involved only one-handed signs, except for the test items in the "Repeating Phrases Subtest" of the BDAE, in which it was not possible to construct phrases without the use of some two- or double-handed signs. It has however been shown by Vaid, Bellugi and Poizner, 1985 (Poizner et al, 1987) that one-handed signers find signing such signs with one hand an easy task, and are well understood by others, and that this does not in itself constitute a language impairment.

4.4.2 Description of Test Construction

A summary of which tests were translated, which adapted and translated, which derived from other test guidelines, and which specially developed, is presented in Table 4.4. All test instructions were given in sign language.

Table 4.4: Tests of SASL translated, adapted and translated, derived, and developed

TRANSLATED	BDAE	Word Discrimination Commands Complex Ideational Material
	Cognitive Test Protocol	SAWAIS Digit Span SAWAIS Arithmetic Paragraph Memory Test Rey Auditory Verbal Learning Test
ADAPTED AND TRANSLATED	BDAE	Body Part Identification Sign Agility Repetition of Words Repeating Phrases and Sentences Responsive Naming
DERIVED	Formal Sign Language Tests	SASL Phonological Processing Tests - Rhyming - Decomposition of signs SASL Morphological Processing Tests - Comprehension of noun/verb distinction - Elicitation of noun/verb distinction SASL Spatialised Syntax Tests - Nominal establishment - Verb agreement with a fixed framework - Verb agreement with a shifting reference
	Narrative Discourse Production	Methods of analysis of evaluation Methods of analysis of spatial referencing
DEVELOPED	Formal Sign Language Tests	Grammatical Facial Expression Tests - Name the facial expression - Choose the correct facial expression - Same/different facial expression discrimination

a) The **Boston Diagnostic Aphasia Examination** (Goodglass and Kaplan, 1983) was adapted for use with deaf signing subjects and translated into SASL. Adapting this test battery for a visual gestural language necessitated numerous modifications. All modifications made to the BDAE are described in Section 4.4.2 below.

b) **The tests for processing SASL phonology, morphology and syntax**, which formed the bulk of the **Formal Sign Language Test Battery**, were constructed using the guidelines mentioned in Poizner et al (1987) for the Salk Institute Formal Language Test Battery. Permission for the use of these guidelines was granted by Dr. U. Bellugi from the Salk Institute for Behavioural Sciences. All

test items included in these tests are original as they were constructed using a SASL lexicon, which differs from that of ASL. All drawings (visuals) used in the Formal Sign Language Tests were constructed by a South African deaf graphic artist on an Amiga computer.

c) The **Grammatical Facial Expression Tests** of the **Formal Sign Language Test Battery** were developed by the researcher. Although numerous tests have been designed to test the recognition of identity of faces and the recognition of facial expressions of emotion, to the best of my knowledge no formal tests have been developed which assess the recognition of facial expressions used to convey linguistic information in sign language. These tests were constructed according to the format used by De Kosky, Heilman, Bowers and Valenstein (1980) in their study of the recognition and discrimination of emotional faces. Photographic material was provided by a deaf photographer.

d) The **Verbal Tests** of the **Cognitive Test Protocol** were directly translated from English into sign language and no modifications were undertaken.

e) With regard to the **Signed Narrative Discourse**, the methods of analysis were based on the methods of analysis of discourse productions of spoken languages. Modifications were made to render them suitable for signed as opposed to spoken discourse productions, and these are described in detail under Treatment of Data (see section 4.7.2.2).

4.4.3 Piloting and Modifications

Subsequent to the initial test construction a pilot investigation was conducted on three deaf subjects with no known history of learning difficulties or any other neurological impairment: a 27 year old male, a 61 year old male and a 18 year old female. Different subjects were used from the control subjects used for the main study. The full battery was administered to all three subjects. The purpose of this pilot investigation was as follows:

- to determine whether there were any gross errors or inconsistencies with regards to test construction and adaption, and

- to determine the suitability of the test material for a deaf signing population and to refine methodological or procedural aspects as well as scoring aspects.

Following this pilot investigation numerous modifications were made to test material, procedural aspects and aspects of scoring.

In order to determine the sensitivity of the final battery to the language problems of a deaf adult with neurological problems, the modified battery was administered to a right hemisphere brain damaged deaf subject. The results are not included in this study, but it was found that the battery was adequately sensitive to aspects under study.

4.5 THE BATTERY OF DIAGNOSTIC TESTS

4.5.1 The Standard Battery of Language Tests

The South African Sign Language adaptation of the Boston Diagnostic Aphasia Examination developed for this study provides an index of a patient's general communication or language capacity and an initial profile of sign language impairments. The first part consists of standardised tests assessing various aspects of production and comprehension, and the second part provides ratings of productive signing. Adapting the BDAE for use with deaf signers provides for a standardised assessment of sign language skills. The BDAE was selected to assess the sign language skills of the learning disabled deaf (LDD) subjects as it is a formal battery recommended for assessing learning disabled hearing persons (Hynd and Cohen, 1983, cited by Hynd et al, 1985). In addition it would allow one to determine if the pattern of impairment following brain damage in deaf signers is comparable to that found in hearing individuals, and finally it would allow for a comparison of the results of this study and those reported by Poizner et al (1987).

There now follows a description of all the subtests of the BDAE used in the SASL version, with a discussion of all the modifications and adaptations found necessary. A full list of the subtests is presented in Table 4.5. Examples of subtests which included modifications are presented in Appendix A.

Table 4.5: Subtests of the BDAE used in this study

COMPREHENSION OF SIGN	Word Discrimination Body Part Identification Commands Complex Ideational Material
SIGNED EXPRESSION	Agility in Sign Automatised Sequences Paraphasia Repetition of Words Repeating Phrases and Sentences Responsive Naming Visual Confrontation Naming Animal Naming
RATING-SCALE PROFILES	Melodic Line Phrase Length Sign Agility Grammatical Form Paraphasia in Running Sign Sign Finding

4.5.1.1 Comprehension of sign

The BDAE tests comprehension as follows. Vocabulary is measured by means of **Word Discrimination** and **Body Part Identification** subtests of single words; the capacity for information is measured by means of **Commands** of increasing length; and intellectual grasp is measured using a set of **Yes/No Questions** demanding increasing power of inference about questions of fact, but not beyond the capacity of average adults (Goodglass and Kaplan, 1983).

Word Discrimination

No modifications were made to this test. The instructions and words were directly translated into SASL. This test is a multiple choice word recognition test. The items fall into six major categories: objects, geometric forms, letters, actions, numbers and colours. Two test cards with drawn visual stimuli are presented to the subject. The examiner signs the target word and the subject is requested to identify the associated picture or symbol.

Body Part Identification

This subtest involves examining the comprehension of names of parts of the body. The first eighteen items sample a wide range of difficulty in body-part names. The subject is requested to point to the body part named by the examiner. A further eight items are included for right/left comprehension and provide a screening test for disorders of parietal lobe function. The signs for many of the body-parts in SASL involve indexing (pointing to) the body part itself, for example, "ear", "nose", "knee", "shoulders", etc. Hence the format of the test had to be modified so as to avoid the function of the test becoming one of repetition rather than comprehension per se. The test was modified to include pictures of the necessary body parts. The examiner points to the body parts on the picture and the subject identifies them on him or herself. The second part of the body part identification test which involves right/left discrimination was not adapted due to the fact that the signs for right and left do not involve indexing the right or left side of the body. The counterpart of this test, **Body Part Naming**, was excluded from the battery as the required response for both comprehension and naming is the same in SASL.

Commands

In this subtest no modifications were made. The test was directly translated into SASL. This subtest examines the capacity to process increasingly concentrated signed information, with commands ranging from one significant informational unit to five. An example of a test item is "Put the pencil on top of the card, then put it back".

Complex Ideational Material

This subtest requires the subject to comprehend and express agreement or disagreement about factual material which is not related to a stimulus immediately before him. The test commences with easy facts and progresses to more complex material relying on reference to knowledge or easy inferences. All material was translated and rewritten using sign language word order. English grammatical structures not used in sign language were omitted. This was done so as to prevent the examiner from reading and presenting the material in signed English as opposed to sign language and thus inhibiting the subjects' ability to comprehend the material. Care was taken to avoid omitting any factual material. An example of a signed test item is "Hammer good cutting wood?" and "Use hammer

hit nail?", which translate into English as "Is a hammer good for cutting wood?" and "Can you use a hammer to hit a nail?"

4.5.1.2 Signed expression

Sign Agility

This subtest involves a single sign repetition task which examines the subjects' sign agility. The subject is required to repeat the sign as many times as possible within a specified time of five seconds. A written form of the signed word is presented if a subject needs to be aided in getting started in the repetition task. Adaptation of this test included changing all test items as the continuum of complexity for the spoken and signed words for the test items was not comparable. The items for the spoken test, which range from easy (mama) to complex (huckleberry), were changed to items which range from formationally simple (like) to formationally complex (weird) in sign.

A continuum of formational complexity in sign was devised using six aspects of sign in which hierarchies of complexity have been proposed, either in relation to their acquisition or to their specific visual, linguistic or motoric properties. All these aspects, with regard to their complexity in the acquisition of sign language, have been documented previously. A summary of these six aspects including previously documented research findings is tabulated in Table 4.6. A four-point scale was devised to rate signs on each aspect from easy to complex, and seven signs were chosen to represent this continuum of complexity. A summary of these scales and of the signs selected appears in Tables 4.7a and 4.7b. It is believed that a factorial analysis would have allowed for a more accurate selection of signs of varying levels of complexity; this was not undertaken as it was beyond the scope of this study.

Automatised Sequences

No modifications were made in this subtest. Four well-overlearned sequences were tested: days of the week, months of the year, numbers from one to twenty-one, and the alphabet.

Table 4.6: Aspects of sign used for determining the complexity of signs in the adaptation of the Sign Agility Subtest of the BDAE

ASPECT	RESEARCH	FINDINGS
handshape (dez)	Boyes Braem's Model 1973 (McIntyre, 1977)	Four stages of development in acquiring the production of ASL handshapes: Stage 1: A, S, G, L, C, and Baby O Stage 2: B, F, and O Stage 3: I, D, Y, P, 3, V, H, and W Stage 4: 8, 7, X, R, and T
nature of the feedback	McIntyre, 1977	Signs made within the field of vision offer potential feedback. In some sense this may make it easier to exercise self correction than if the sign is made outside the field of vision, when there is only kinaesthetic or haptic feedback
complexity of the sign action (sig) required by the sign	McIntyre, 1977	Although there is no systematic and empirical evidence regarding the acquisition of sign, it would seem likely that a repetitive touching movement would be an easier sign to produce than a sign with an interchanging action.
continuum from iconicity to opaqueness	Brown, 1977; Griffith & Robinson, 1980; Griffith et al, 1981; Hoemann, 1975; Stokoe, 1975, cited by Luftig, 1983	Iconic signs are easier to learn than non-iconic. - iconic signs are guessable, physically resembling the referents - transparent signs - a relationship between a sign and its referent is easily guessable - translucent signs - there is a degree of relationship between a sign and its gloss, identifiable when both sign and its referent are known - opaque - nonguessable, unable to perceive origin of sign
concreteness versus abstractness	Abbot, 1975; Begg & Robertson, 1973; Gallagher, 1970; Paivio, 1980, cited by Luftig, 1983	concrete words are easier to learn than abstract
conventional versus unconventional	Bellugi & Klima, 1972; Frishberg, 1975; Harrel et al, 1973; Stokoe, 1970, 1976, cited by Luftig, 1983	conventional signs used in a community are easier to learn than unconventional signs

Table 4.7a: Numerical values allocated to represent the complexity of the six aspects of sign

ASPECT	NUMERICAL VALUE
A Handshape	
Stage 1	1
Stage 2	2
Stage 3	3
Stage 4	4
B Nature of Feedback	
within field of vision	1
outside field of vision	4
C Complexity of Sign Action	
repetitive touching motion	1
interchanging action	4
D Continuum of Iconicity to Opaqueness	
iconic	1
transparent	2
translucent	3
opaque	4
E Concreteness versus Abstractness	1 4
F Conventional versus Unconventional	1 4

Table 4.7b: Numerical values assigned to the seven signs selected for the Sign Agility Subtest of the BDAE

	Aspects						
Signed test items	A	B	C	D	E	F	Total
"like"	1	1	1	1	1	1	6
"smell"	2	1	1	2	1	1	8
"submarine"	2	4	1	2	1	1	11
"listen"	3	4	4	3	1	1	16
"bad luck"	3	4	4	4	4	1	20
"hook"	4	4	4	4	4	1	21
"weird"	4	4	4	4	4	4	24

Paraphasia

Paraphasia is tabulated in specific BDAE subtests. In spoken languages phonemic paraphasias occur when there is a transposition or introduction of extraneous phonemes in a spoken word. In sign language, phonemic paraphasias occur when there is a substitution of one sublexical element (a change in handshape, location or movement) (Poizner et al, 1987). Verbal paraphasias in sign involve the substitution of one sign for another and neologistic distortions are substitutions or introductions of extraneous sublexical elements which result in most of the sign not being recognisable as a unit (Poizner et al, 1987).

Repetition of Words

In this subtest the subject is required to repeat single signs. In the original subtest a wide sampling of word types is presented, including a grammatical marker, objects, colours, letters, numbers, an abstract verb of three syllables and a tongue twister. Six out of the ten items involved two-handed signs. These items were substituted with one-handed signs belonging to the same semantic categories. The tongue twister was replaced with a formationally complex sign, as determined by the scale used in the **Sign Agility Test.**

Repeating Phrases and Sentences

This subtest is divided into two separate sets of sentences which are scored separately. They differ in difficulty of vocabulary and predictability of the content and are referred to as "high probability" and "low probability" sentences. An example of a high probability sentence is "I saw him on TV last night" and an example of a low probability sentence is "The lawyer's closing argument convinced him". The subject is requested to repeat the signed sentence after the examiner. The high probability and low probability sentences are presented alternately. Modifications of test items involved some of the high probability phrases which are not applicable to the deaf, such as "I heard him speak on the radio last night", which was modified to "I saw him on T.V. last night". In the low probability phrases the signers assisting in test construction did not have a sign in their repertoire to match words such as "pry" and "heath" and hence these words were substituted by words with a similar meaning.

Responsive Naming

This subtest involves examining the subjects' word-finding ability. The stimulus question is signed to the subject and usually contains a key word which is a close associate of the expected response. Modification of seven out of ten items was necessary as the signed stimulus question and the required signed response involved the same sign, only differing in one formational parameter such as movement. For example, in the question "What do we shave with?", which has the expected response "razor", the key word in the question, "shave", shares the same place of articulation and handshape as "razor" and differs only in manner of movement. Hence items of this nature were substituted with items in which the key word in the question and in the expected response were close word associates but formationally less related, for example "What do we stir with?", which has the response "spoon" (see Figure 4.1).

RAZOR

SHAVE

(A) Original stimulus question and required response - too similar in sign, sharing the same handshape and place of articulation and differing only in the manner of movement

SPOON

STIR

(B) New test item in which the keyword and required response differ in place of articulation and movement and only share the same handshape

Figure 4.1: Example of adaptations made to the Responsive Naming Subtest of the BDAE

Visual Confrontation Naming

No modifications were required for this subtest, in which the subjects are required to name visually presented items. The visual material consists of the same cards used for the **Word Discrimination** subtest. Hence this task involves the naming of items within the six major categories of objects, geometric forms, letters, actions, numbers and colours.

Animal Naming (Fluency in Controlled Association)

No modifications were made to this subtest, in which the subject is required to name as many animals as possible in 90 seconds. The procedure suggested by Goodglass and Kaplan (1983) is an adaption of the Stanford Binet procedure for animal naming, and involves giving the subjects preliminary instructions to consider animals of all varieties (such as birds, reptiles, farm animals, etc.) and finally providing a starting word, "dog".

4.5.1.3 Rating-scale profiles of the BDAE

The second part of the BDAE as adapted for SASL involves ratings for six of the seven different aspects of sign production: melodic line, phrase length, sign agility, grammatical form, paraphasia in running sign and sign finding. These ratings were conducted using the principles suggested in Goodglass and Kaplan (1983) but adjusted for characteristics of sign language outlined by Poizner et al (1987). The narrative discourse samples (see below) provided the data-base for the rating-scale profiles.

Melodic line

In the BDAE, melodic line refers to the number of words produced within an intonational contour. Poizner et al (1987) have noted that melodic line is not a property of signing or gesturing. However what is comparable is "rhythmicity". The rhythmic flow of signing is a significant measure as it provides evidence that a string of signs, whether signed fluently or not, represent phrasal or sentential structure rather than merely a string of signs linked together associatively (Poizner et al, 1987). The rating must reflect the number of signs in a single rhythmic grouping. A seven-point scale is used. At the intermediate level (4), normal melodic line may extend to three- or four-word expressions of a stereotyped nature, such as "I don't know". Patients whose sentences never exceed

four words in length can obtain a maximum rating of 4. Two interpolated steps are provided between the midpoint and each extreme.

Phrase length

This is the maximum number of recurring number of signs in an uninterrupted run, bounded by pauses or sentence markers. The numerical steps of the seven-point scale represent the longest number of words per run which occurs at least once in about ten starts by the subject. Thus this rating is not the average length of uninterrupted word groupings, but the longest grouping which may be expected occasionally. The criterion of one in ten is given as a single guide for estimation by the rater.

Sign agility

This is the ease with which the subject articulates signs and signed sequences. Any awkwardness is noted. On a seven-point scale, the subject receives a maximum score of 7 if every word is produced with normal ease. A rating of 1 indicates articulatory difficulty in every utterance. The middle score of 4 implies that articulation is normal in overlearned expressions. Two interpolated steps are provided between the midpoint and extremes.

Grammatical form

This involves a continuum from one word sentence signing (agrammatic) to a normal variety of grammatical forms. At the moderate level the subject produces simple signed sentences, with little variety in grammatical form. At normal levels longer sentences with a variety of grammatical forms are found. Paraphasic errors and aborted sentences are compatible with normal ratings.

Paraphasia in running sign

The focus here is on substitutions or insertions of semantically erroneous words in running conversation. Partially or completely neologistic errors are also noted. The score depends primarily on the prevalence of such errors. A score of 1 implies paraphasia in every utterance, the maximum of 7 implies a complete absence of paraphasia and the midpoint 4 represents an average of a paraphasic error in each minute of conversation.

Sign finding

This rating is made with respect to the level of fluency. It reflects in a quantitative sense the ratio between the number of substantives and specific action signs and the number of low information signs, that is, grammatical connectives, pronouns and indefinite words such as "something" and other compounds of "thing," "place," and "body". Unlike in the other scales, normal performance is not reflected by a score of 7 and the most deviant by a score of 1. In this instance a rating of 7 reflects signing which consists almost exclusively of substantives and picturable actions. The lack of low information signs is usually reflected in short agrammatic sentence forms. A rating of 4 indicates that the examiner estimates the number of specific nouns and verbs to be just appropriate to the fluency level. A rating of 1 would reflect signing in which no specific nouns or verbs occur. Such signing would be "empty", vague and circumlocutory, with the same signs recurring frequently; it would however be grammatically organised.

4.5.2 Formal Sign Language Tests

This battery of tests was employed so as to assess language comprehension and processing for each of the following levels of structure in SASL: sublexical, morphological and syntactical. The Grammatical Facial Expression Tests were used to assess the processing and comprehension of facial expressions which convey linguistic information in SASL. A list of the tests used in this battery is displayed in Table 4.8. Instructions and examples of test items for selected tests can be found in Appendix A.

Table 4.8: Battery of Formal Sign Language Tests

SASL PHONOLOGICAL PROCESSING TESTS	Rhyming Test Test for Decomposition of Signs
SASL MORPHOLOGICAL PROCESSING TESTS	Comprehension of Noun/Verb Distinction Elicitation of Noun/Verb Distinction
SASL SPATIALISED SYNTAX TESTS	Nominal Establishment Verb Agreement with a Fixed Framework Verb Agreement with a Shifting Reference
GRAMMATICAL FACIAL EXPRESSION TESTS	Name the Facial Expression Choose the Correct Facial Expression Same/Different Facial Expression

There now follows a description of each subtest in this section and how it is constructed.

4.5.2.1 SASL phonological processing tests

Rhyming

In the rhyming test, phonological processing is assessed. The subject is required to look at three pictures of objects and identify two pictures whose signs "rhyme" (i.e. differ in only one of the three major parameters of signing). The third picture involves a semantic distracter. There is one practice example to familiarise the subject with the task involved and 5 test items for each of the following categories: same handshape / same place of articulation: same handshape / same movement; same place of articulation / same movement.

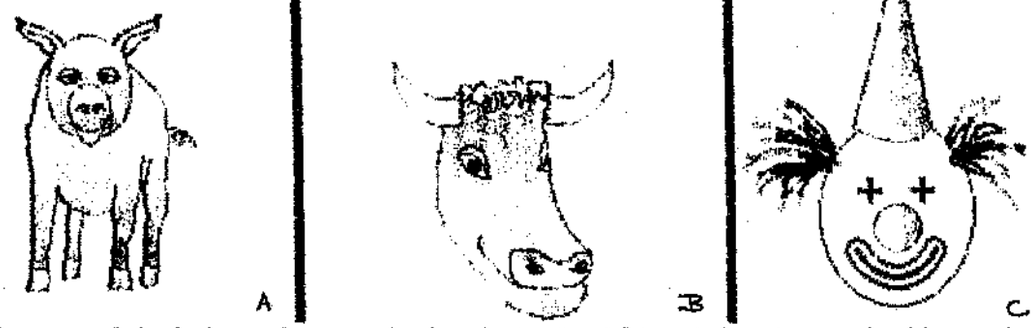
An example of a test item for [illegible] parameter is illustrated in Figure 4.2.

Decomposition of Signs

In the construction of this test, familiar signs which are easily represented pictorially were selected. The test consists of three examples and fifteen test items. For each of the major formational parameters - hand configuration, place of articulation and movement - there is one example and five sets of test items. For each test item the subject is shown four pictures. Firstly, the examiner and subject name the four pictures together, adopting the sign used by the examiner, then the examiner signs a word and the subject is instructed to select the picture that represents a sign with either the same hand configuration, the same place of articulation or the same movement. The other pictures include a semantic distracter, a formational distracter (picture of an object representing a sign similar in another component to the target sign) and a phonological distracter (picture of a word with the same initial phoneme as the signed word).

Instructions, including which formational parameter must be focused on, are repeated prior to testing the decomposition of each new formational parameter. The test item for each formational parameter can be seen in Figure 4.3.

SAME HANDSHAPE / SAME PLACE OF ARTICULATION

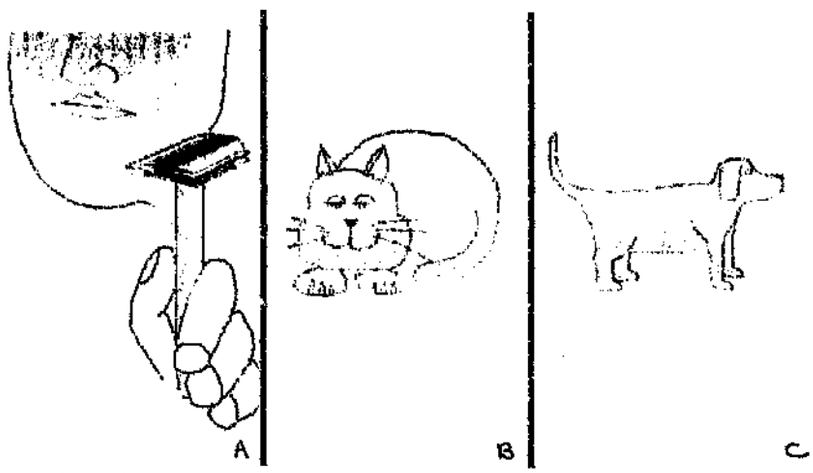


The correct choice is A and C because the signs for "pig" and "clown" share the same handshape and place of articulation

SAME HANDSHAPE / SAME MOVEMENT

The correct choice is A and B because the signs for "red" and "worm" share the same handshape and movement

SAME PLACE OF ARTICULATION / SAME MOVEMENT

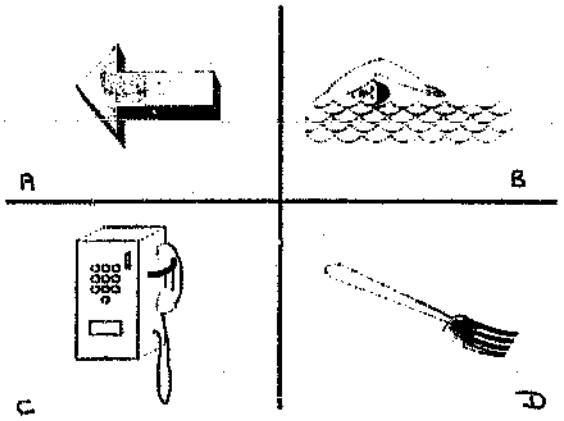


The correct choice is A and B because the signs for "shave" and "cat" share the same place of articulation and the same movement

Figure 4.2: Examples of test items from the Rhyming Test

TARGET HANDSHAPE

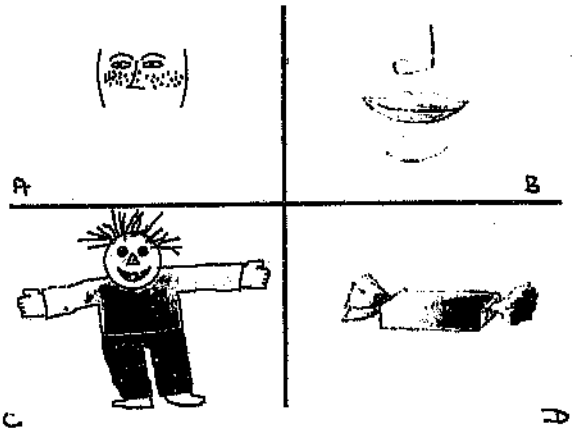
presented sign: "aeroplane"



The correct choice is C because the sign for "telephone" has the same handshape as the presented sign "aeroplane"

TARGET PLACE OF ARTICULATION

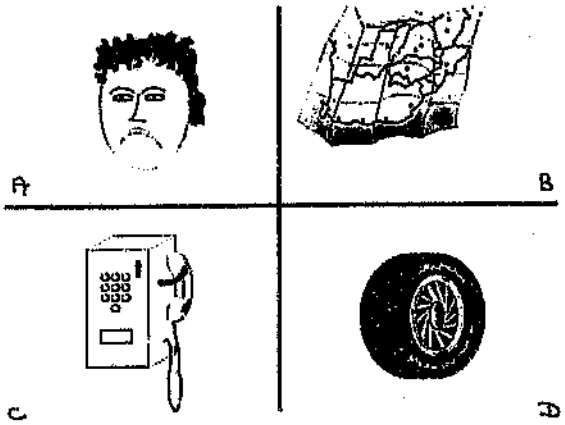
presented sign: "dimple"



The correct choice is D because the sign for "sweet" shares the same place of articulation as the presented sign "dimple"

TARGET MOVEMENT

presented sign: "mad"



The correct choice is D because the sign for "wheel" has the same movement as the presented sign "mad"

Figure 4.3: An example of a test item for each major formational parameter from the Decomposition Test

4.5.2.2 SASL morphological processing tests

The following two tests examine comprehension and elicitation of noun/verb distinctions.

As explained in Chapter Two, the distinction between noun/verb pairs is made by patterns of movement. Semantically associated noun/verb pairs, such as "gun/shoot", "aeroplane/fly", "scissors/cut", have the same handshape, place of articulation and movement shape but are differentiated by features of movement such as frequency, end manner and directionality.

Comprehension of Noun/Verb Distinction

This test was developed so as to assess the comprehension of noun/verb distinctions in sign. The test consists of twelve test items. The examiner signs either the noun or the verb from a related pair and the subject designates which of four pictures illustrates the sign. The four pictures represent the object referred to by the noun, the action referred to by the verb, a formational distracter (a sign in which one of its formational parameters are the same as the target sign) and a semantic distracter.

No voicing or mouthing was permitted by the examiner during presentation of test items as this was found to assist the subjects in providing the correct response.

Elicitation of Noun/Verb Distinction

This test was constructed so as to assess the production of noun/verb distinctions. The test consists of ten items. The subject looks at a picture of an object or an activity, representing the noun or verb respectively of a related pair. The examiner then asks the question "What is that?" (to elicit a noun) or "What is she/he/it doing?" (to elicit a verb). The examiner then observes whether the subject signs the noun or the verb with the correct distinction. An example of a test item is provided in Figure 4.4.

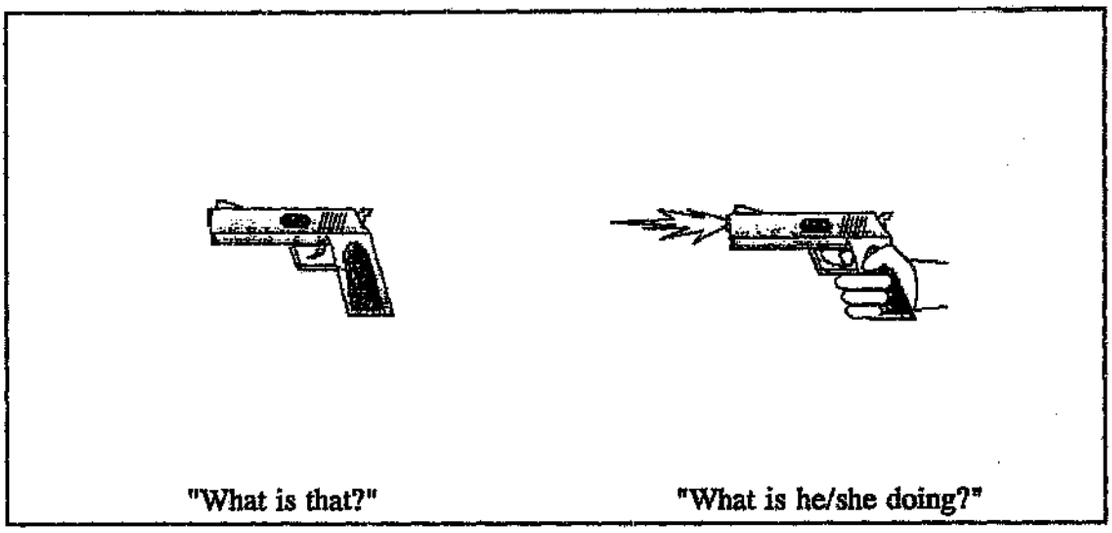


Figure 4.4: Example of a test item from the Elicitation of Noun/Verb Distinction Test

4.5.2.3 SASL spatialised syntax tests

As discussed in Chapter Two, sentence structure in SASL can be determined by the way in which verb, nominal and pronominal indexes are related to one another in space.

Three tests were constructed in order to examine the processing of such spatialised syntax, the **nominal establishment** test and two tests of **verb agreement**, one in a fixed framework and the other with a shifting reference.

Nominal Establishment

This test probes perception and memory for spatial loci associated with specific nominals. The test consists of ten items. Half of the test has two nominals on each list and the other half has three nominals.

The examiner signs a test item and asks two questions: where a certain nominal has been established (to which the subject answers by pointing to a specific locus in signing space), and what nominal has been established at a certain locus (by which the subject answers by signing the nominal) (see Figure 4.5).

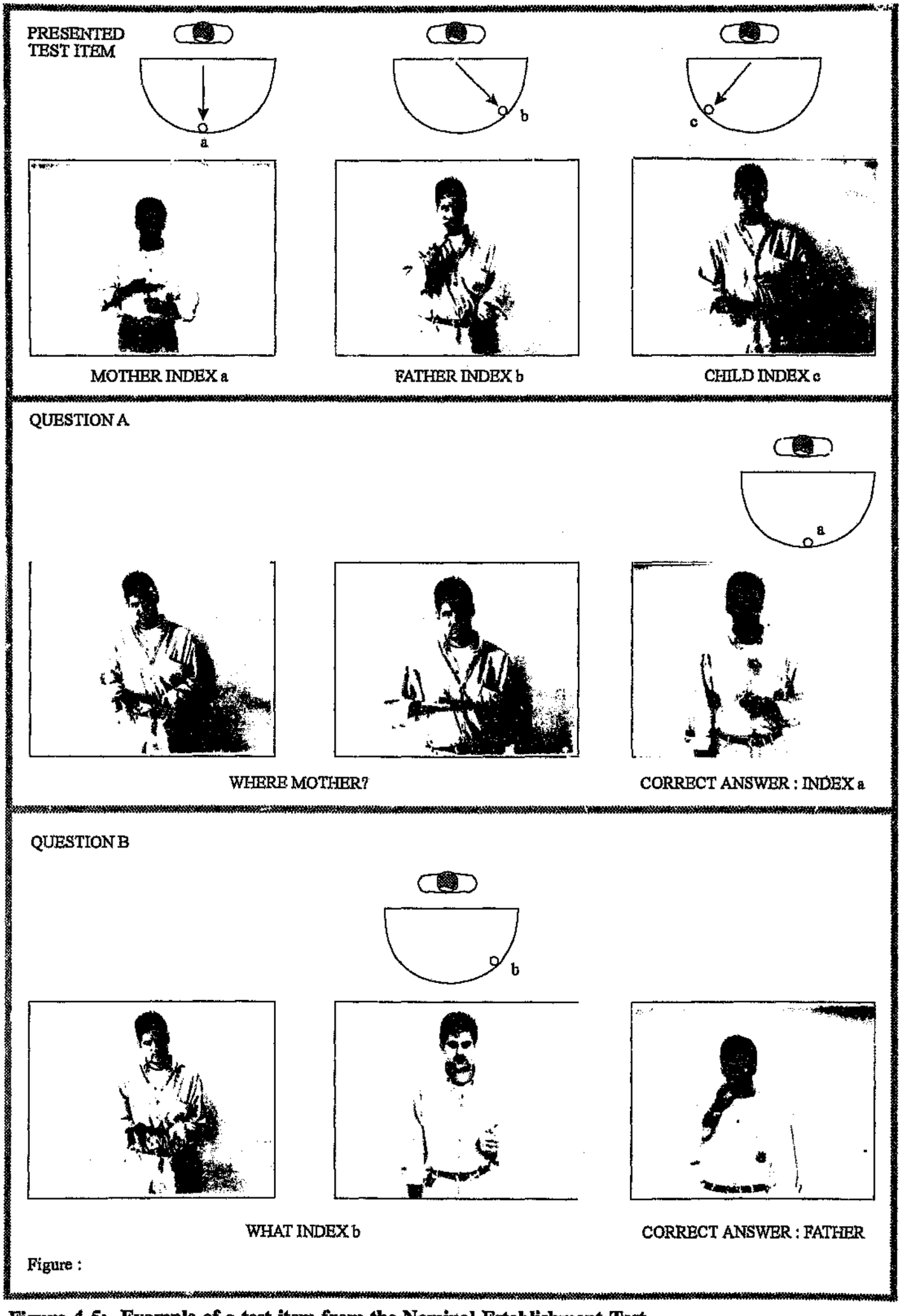


Figure 4.5: Example of a test item from the Nominal Establishment Test

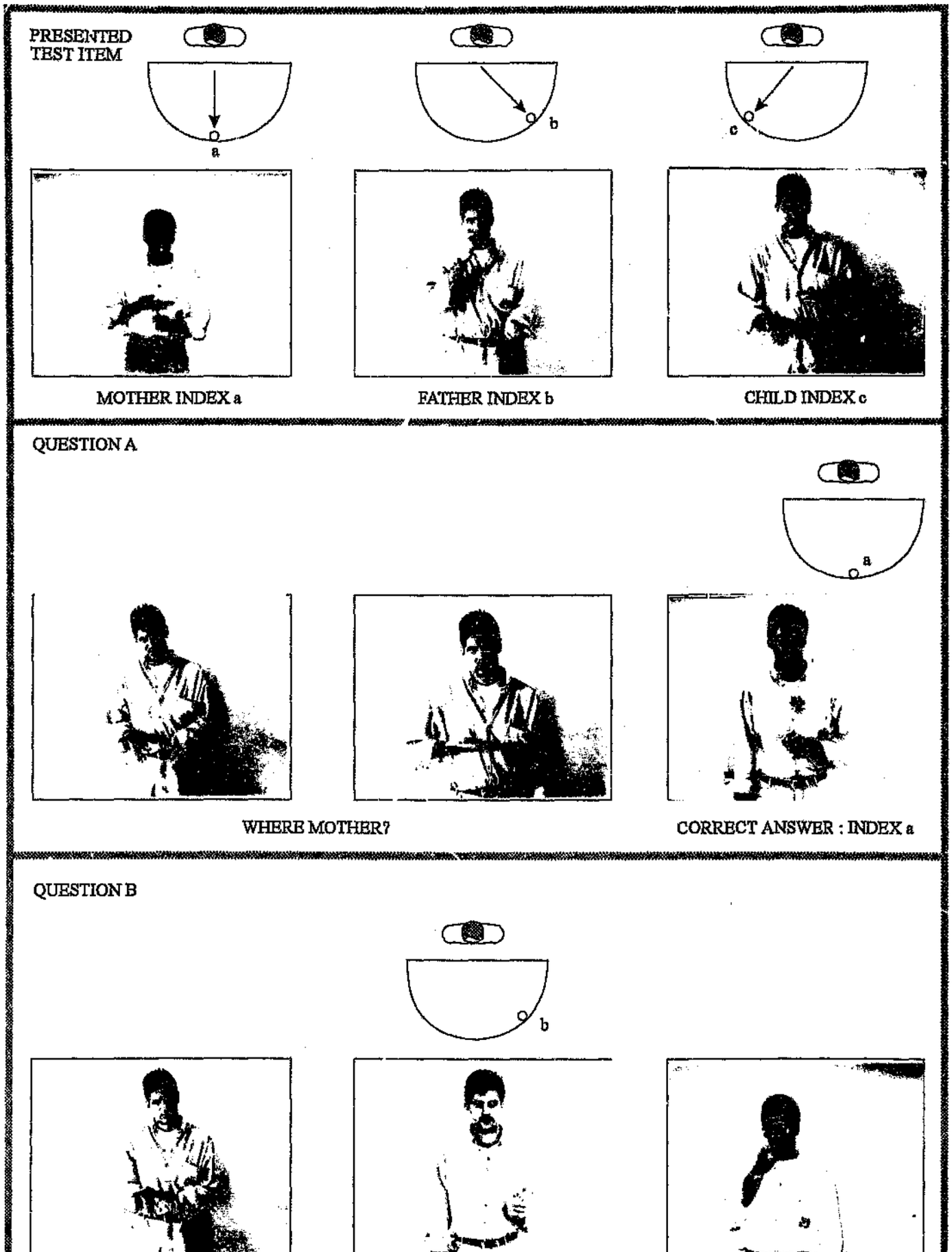


Figure 4.5: Example of a test item from the Nominal Establishment Test

Verb Agreement with a Fixed Framework

This test investigates the memory and processing of verb agreement markers in SASL. The test consists of ten items. The examiner signs a sentence describing an event with two participants, either of which could semantically be the subject or object of the verb.

Examples of two test items which are presented at different times in the test are:

- CAT INDEX$_{(a)}$ MOUSE INDEX$_{(b)}$ $_{(a)}$CHASE$_{(b)}$
  "The cat chased the mouse."

- CAT INDEX$_{(a)}$ MOUSE INDEX$_{(b)}$ $_{(b)}$CHASE$_{(a)}$
  "The mouse chased the cat."

In both instances the same signs are presented in the same order but with different spatial endpoints of the verb. The spatial pronominal indexes and order of signs are maintained, and the only indicator of grammatical relations is the movement of the verb between spatial points (see Figure 4.6). The subject is required to point to the picture described by the examiner's sentence. A correct response involves processing and remembering the nominals and their associated spatial loci as well as the direction of the movement of the verb between the spatial loci.

Verb Agreement with Shifting Reference

This test requires processing a shift of spatial reference as there is no identity between the spatial loci of the presented sentence with those of the test question. The test includes fourteen test items. The test again involves describing events with two participants, either of which semantically could be the subject or object of the verb, for example, the verb "hit" and the two arguments "boy" and "girl":

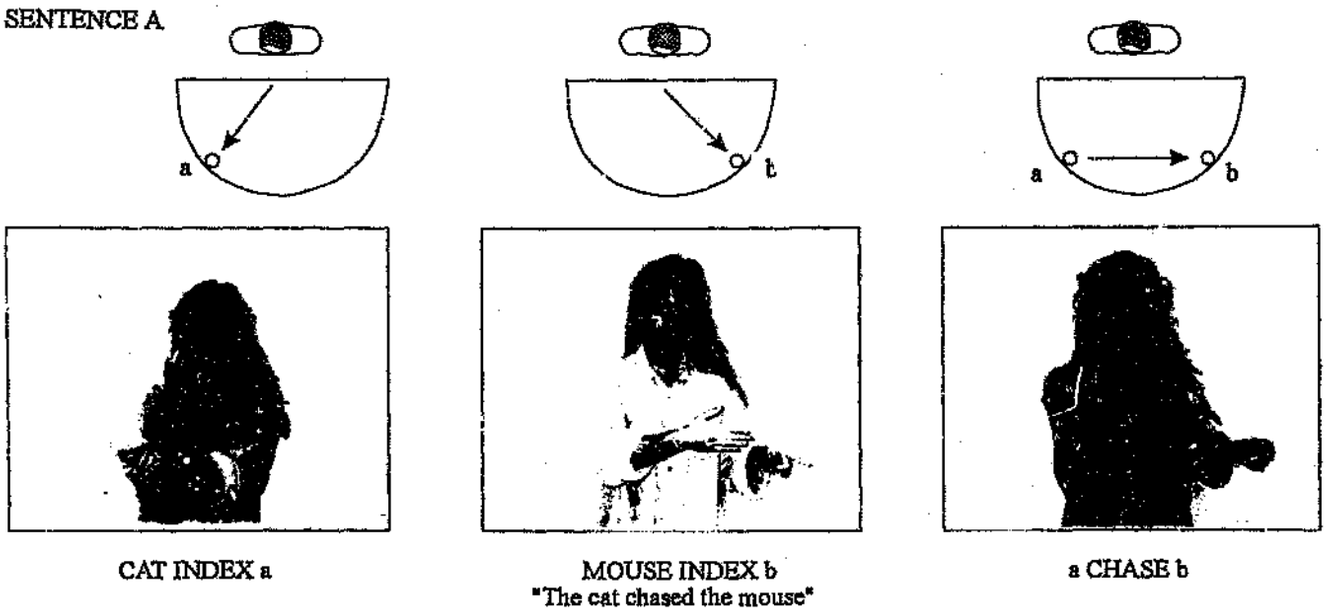
- GIRL INDEX$_{(a)}$ BOY INDEX$_{(b)}$ $_{(a)}$HIT$_{(b)}$
  "The girl hit the boy".

- GIRL INDEX$_{(a)}$ BOY INDEX$_{(b)}$ $_{(b)}$HIT$_{(a)}$
  "The boy hit the girl".

The examiner then asks the subject two questions in random order about the sentence. These questions are equivalent to asking "Who was the recipient of the action?" (Who got hit?) and "Who was the agent of the action?" (Who did the hitting?) (see Figure 4.7).

VERB AGREEMENT WITH A FIXED FRAMEWORK
Example of a test item.

SENTENCE A

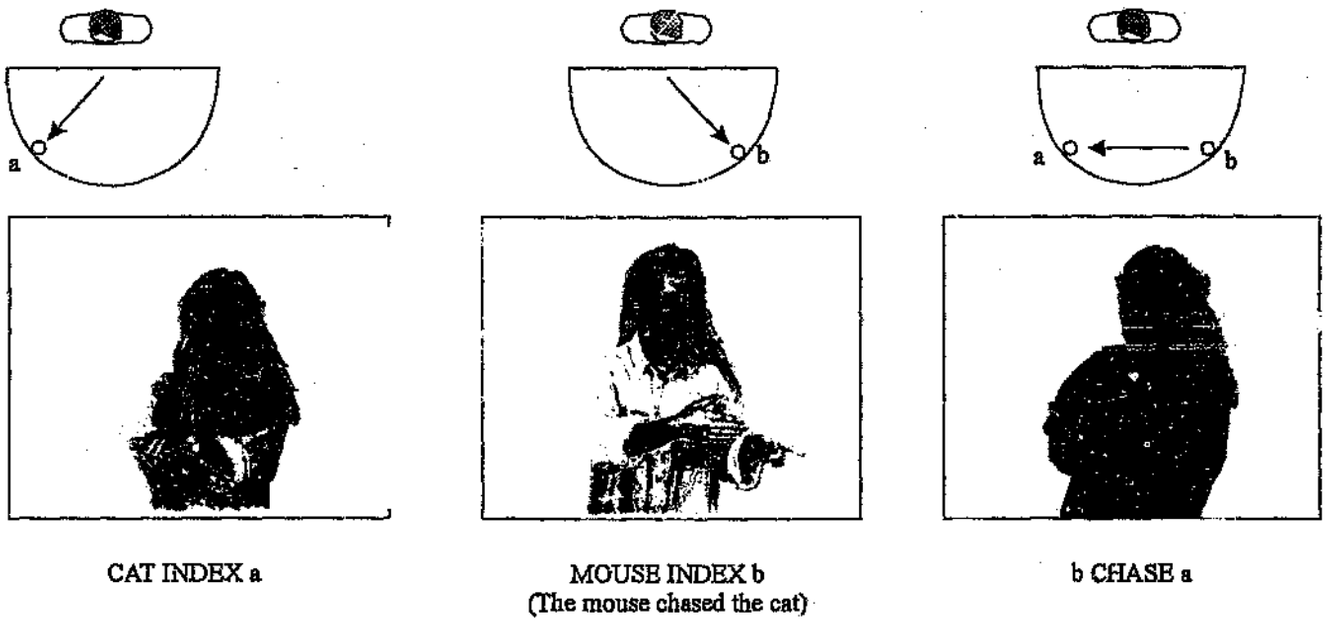


CAT INDEX a

MOUSE INDEX b
"The cat chased the mouse"

a CHASE b

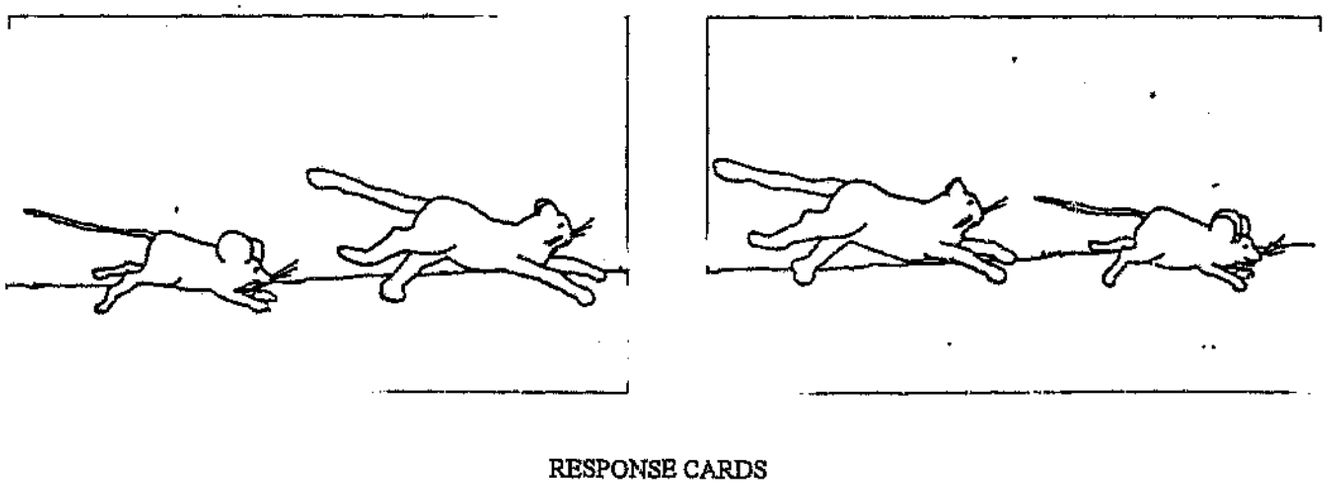
SENTENCE B



CAT INDEX a

MOUSE INDEX b
(The mouse chased the cat)

b CHASE a

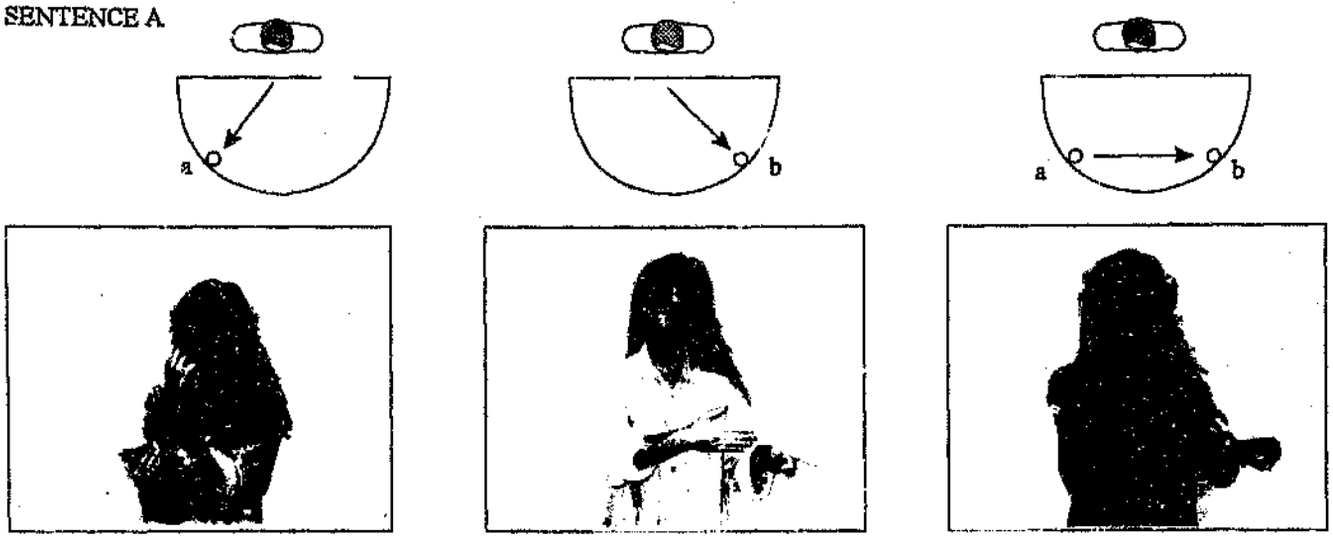


RESPONSE CARDS

Figure 4.6: Example of a test item from the Verb Agreement with a Fixed Framework Test

VERB AGREEMENT WITH A FIXED FRAMEWORK
Example of a test item.

SENTENCE A

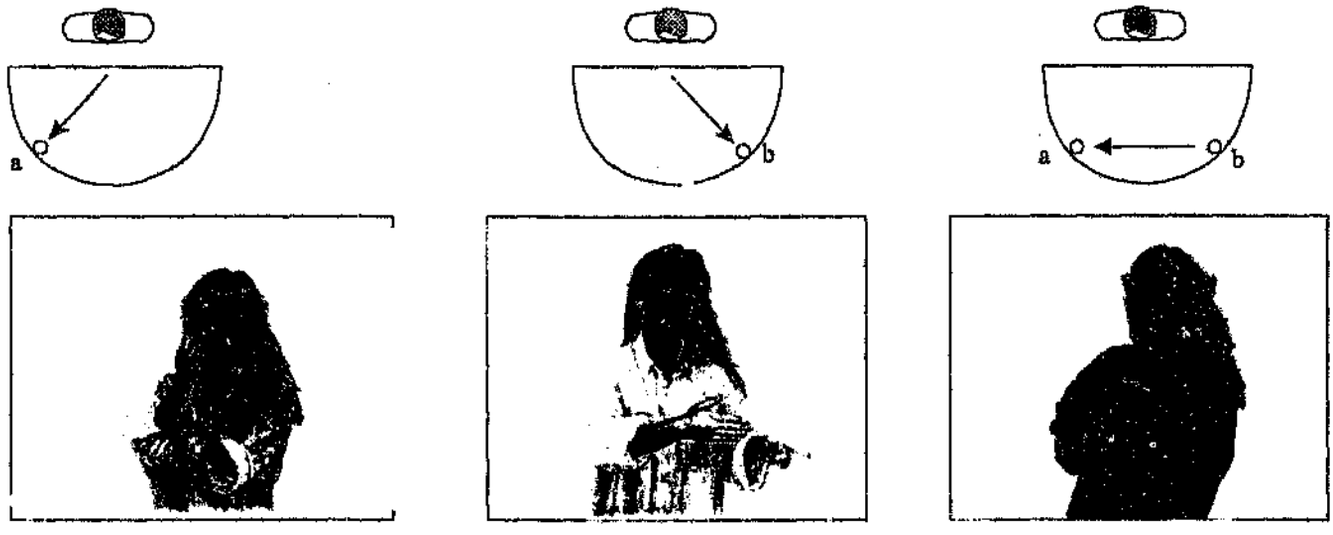


CAT INDEX a

MOUSE INDEX b
"The cat chased the mouse"

a CHASE b

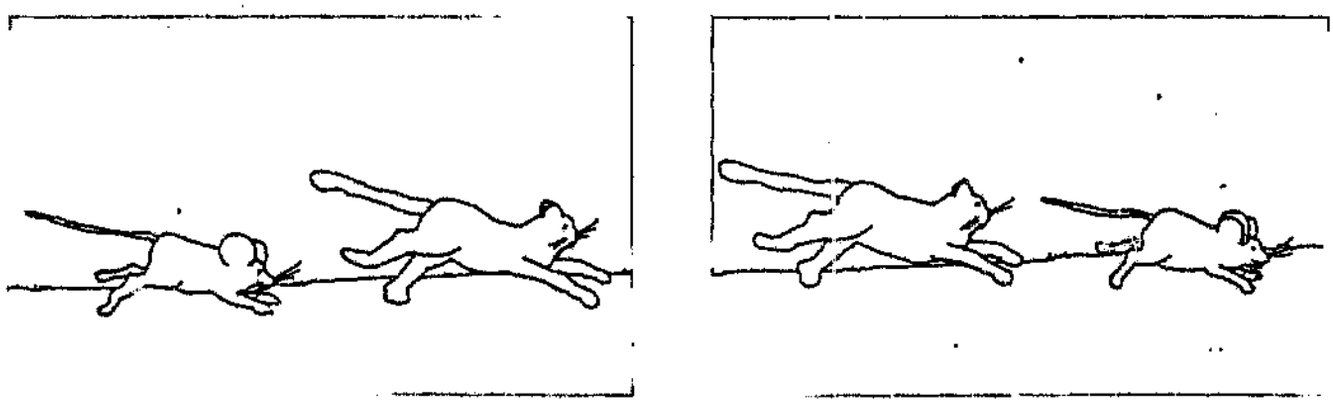
SENTENCE B



CAT INDEX a

MOUSE INDEX b
(The mouse chased the cat)

b CHASE a



RESPONSE CARDS

Figure 4.6: Example of a test item from the Verb Agreement with a Fixed Framework Test

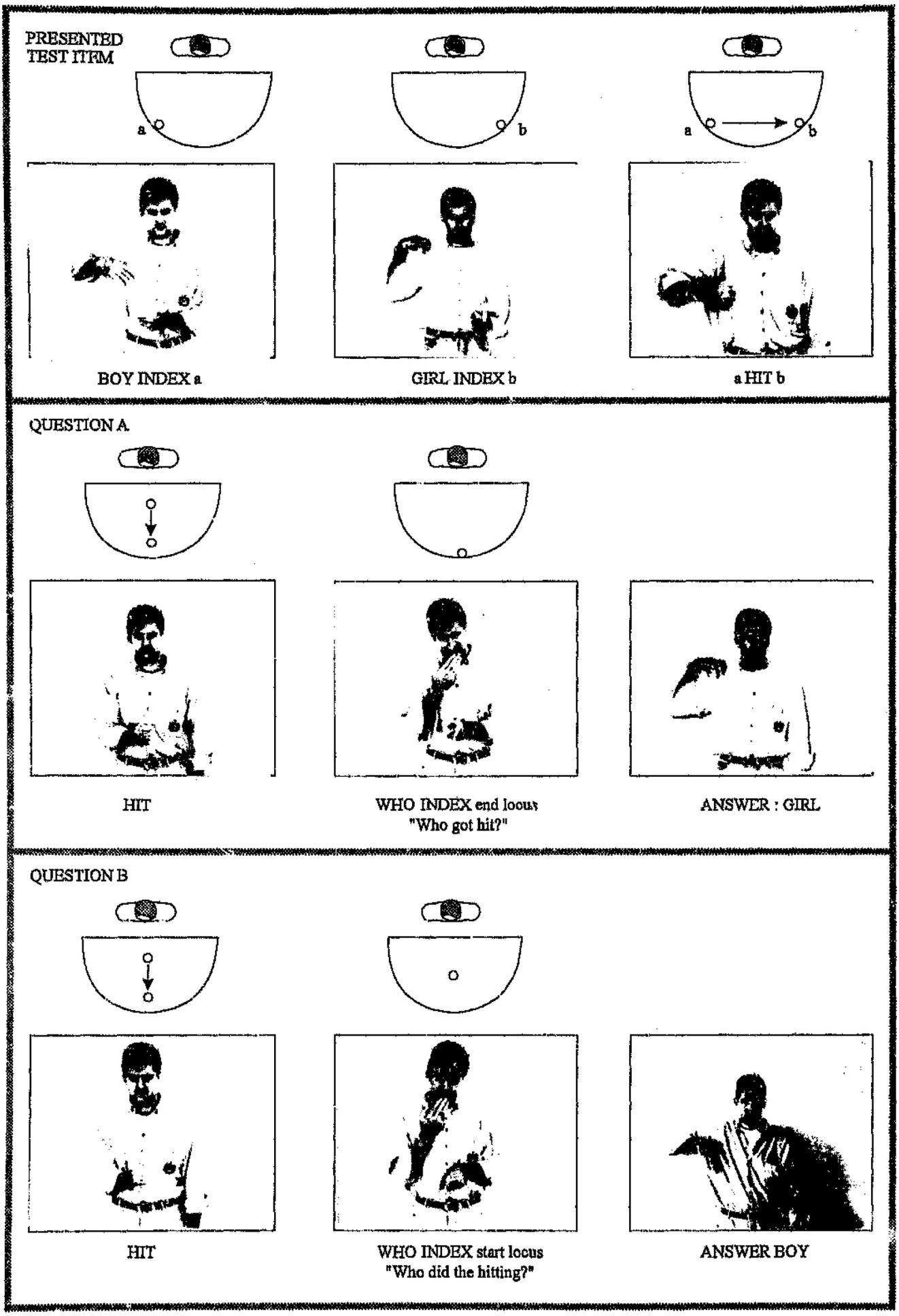


Figure 4.7: Example of a test item from the Verb Agreement with a Shifting Reference Test

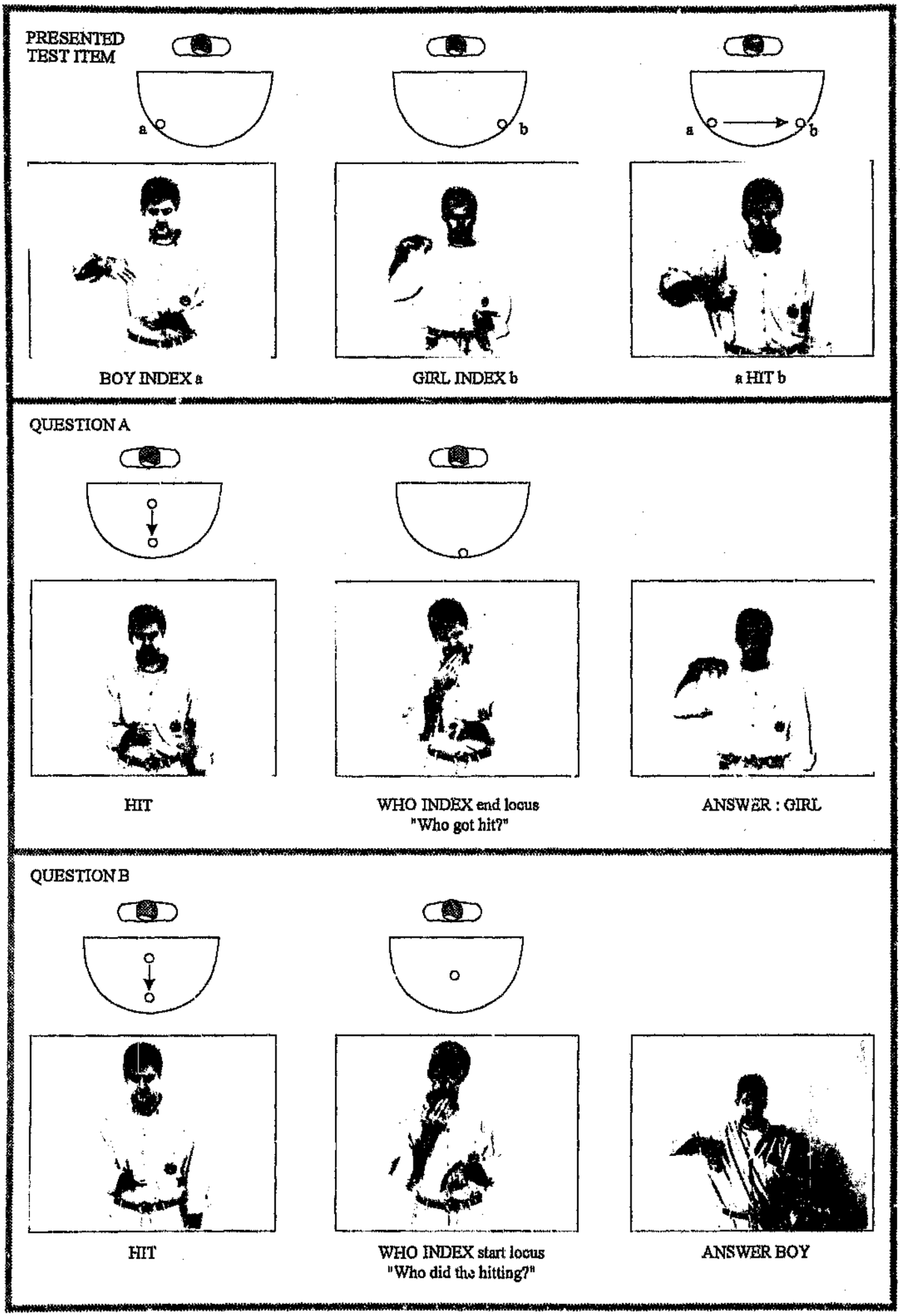


Figure 4.7: Example of a test item from the Verb Agreement with a Shifting Reference Test

4.5.2.4 Grammatical facial expression tests

Facial expression plays a variety of grammatical roles in sign language and is necessary for understanding the structure of SASL utterances (see Chapter Two). The following three tests were designed to assess the subjects' ability in the recognition of facial expressions used in sign language: **Name the Facial Expression, Choose the Correct Facial Expression,** and **Same/Different Facial Expression Discrimination.** These tests were piloted on a group of six nondisabled deaf subjects before being administered to the experimental subjects (see Appendix C).

In addition, the results of each subject's performance on these three subtests was considered in conjunction with their expressive use of facial expressions in their narrative discourse samples. Furthermore it was hoped that the results from these subtests in conjunction with the results of the subjects' performances on the Benton Facial Recognition test might shed more light on the question of the neurological mechanisms involved in the recognition of facial expressions.

As discussed in Chapter Two, research findings on nonmanual behaviours indicate that facial signals in ASL function as grammatical markers in three basic ways: marking specific syntactic structures, representing adverbs, and accompanying specific lexical items (McIntire and Reilly, 1988). In the three subtests, examples of the following two types of grammatical markers were measured:

- facial signals **marking syntactic structures**: yes/no and wh- questions, and negation
- facial signals **representing adverbs**: "mm" (relaxation and enjoyment) and "th" (inattention, carelessness and unawareness).

A discussion of each of these facial expressions functioning as grammatical markers was undertaken in Chapter Two. The facial expressions used to signal **questions, negation, "mm"** and **"th"** were selected for the following reasons:

- The test material is presented in the form of photographs, which can only convey facial expressions and head orientation, not head movement or body posture,

movement or orientation. In all of these selected facial expressions, the facial expression alone, without head or body movement or the manual component, is sufficient to carry the necessary linguistic information.

- Use of these facial expressions in sign languages elsewhere has been well documented in the literature.
- These facial expressions have been observed in SASL.

The third function of nonmanual behaviours, **accompanying specific lexical items**, was not included in these tests as these nonmanual features are lexically bound and the manual component would have had to be displayed. The expressive use of these facial signals was however examined in the subjects' discourse productions.

Photographs of four South African deaf signers, each displaying the above-mentioned facial expressions, were taken. These photographs only portray facial expressions and head orientation. The photographs are in black and white and are 12,5cm in height, and 8cm in width, mounted on rectangular pieces of white matte cardboard measuring 17,5cm in height and 22cm in width. An example of a facial expression from each of the four categories is displayed in Figure 4.8. Examples of test items can be seen in Appendix A.

Name the Facial Expression

This task focuses on the categorisation of facial expression rather than on matching a sample of a particular facial expression. It does not require the subject to state whether a target expression is the same as or different from a given expression, but requires the subject to identify and name the grammatical information portrayed by a given facial expression. The task includes facial stimuli and the employment of verbal cues.

On each trial the subject is presented with a photograph of one of the four deaf signers displaying one of four facial expressions. The subject is provided with the four options: question (yes/no or wh- question), negation, relaxation and enjoyment (mm), and inattention and lack of control (th), and is required to select one to name the grammatical facial expression in the photograph. The choices remain in written display throughout the duration of the test. There are sixteen trials involving pictures of each of the four signers portraying each of the four different facial expressions.

question

negative

"mm" - relaxation, enjoyment

"th" - inattention

Figure 4.8: Examples of facial expressions from each of the four categories: questions, negatives, "mm" and "th"

Choose the Correct Facial Expression

This task requires the subject to discriminate between four different facial expressions and identify the correct facial expression. As noted by Bogen, 1969 (Hansch and Pirrozolo, 1980) a task of this nature requires a serial and analytic mode of processing.

The photographs of the four facial expressions as modelled by the same signer are presented to the subject together. On each occasion the examiner names a facial expression and the subject must select the correct photograph. The test involves sixteen trials. Each signer's pictures are presented four times in the course of the test and the subject is asked to identify a different grammatical feature each time.

Same/Different Facial Expression Discrimination

This task requires the subject to recognise whether a target expression is the same as or different from the given expression. Strauss and Moscovitch (1981) note that both types of responses, indicating that the stimulus is different from or the same as the target, must be assessed, given current concerns that different processes may underlie the two judgements.

The subject is presented with two pictures of the same signer with either the same or different facial expressions. There are twelve trials, in six of which the pictures are the same and in six of which they are different. They are presented in random order. Subjects are asked whether the two photographs presented are the same or different.

4.5.3 Narrative Discourse Task

"By virtue of its complexity, discourse entails integration of all types of linguistic knowledge" (Bayles and Kaszniak, 1987, cited by Glosser and Deser, 1990, p.69). Analysis of discourse production allows for simultaneous examination of the breakdown in "purely" linguistic functions (e.g. phonology, syntax and semantics) as well as in language functions that interact with higher order conceptual structures (Glosser and Deser, 1990; Joanette et al, 1986). The clinical application of narrative analysis has been motivated by the need to document not only the linguistic performance but also the communication of children and adults with various types of language impairment (Merrit

and Liles, 1989; Ulatowska, North and Macaluso-Haynes, 1981). Westby (1984) claims that language assessment is incomplete without evaluating narratives.

Due to the scope of this research only one type of discourse was chosen as part of the assessment battery. Narrative was chosen as it is a discourse type which has been studied most extensively by representatives of a number of different disciplines, thus creating an expanding body of knowledge available to researchers in applied fields (Ulatowska, Freedman-Stern, Doyle and Macaluso-Haynes, 1983). It is the one type of discourse the structure of which has been relatively well characterised and an increasing number of studies have focused on these characteristics of narrative discourse in both normal and pathological subject populations (Joanette et al, 1986).

4.5.3.1 Material used for the narrative discourse task

Within narrative language tasks there can be considerable variation depending upon the instructions used in presenting the tasks and the specific materials used to elicit the narratives (Westby, 1984). As noted by Westby, telling a story from a wordless picture book is a conceptually easier task than, for example, formulating a story about a single poster picture. Wordless picture books require only that an individual recognise the schemas depicted.

For the purposes of this research it was decided to employ the easier task so as to ensure the production of longer samples of discourse. In addition this material was selected so that there would be no influence of English text on the subjects' spontaneous signing. The particular story chosen was "The Snowman" by Raymond Briggs. "The Snowman" has been used previously in South African and international sign language research (Bristol Sign Language Study Centre, UK). The subjects were required to look at the pictures and memorise the story, and then relate the story to the examiner. The naive listener condition was created in order to maximise the verbal productions of each subject, consistent with Liles' (1985) findings that language disordered children produced longer and more coherent narratives with a naive listener than with a listener who had shared a viewing.

Kyle (1983) noted that in recent tradition a way of studying sign narrative is to consider stories, particularly the recall of stories. Although it may be argued that memorising a story may confound memory and linguistic deficits it was felt that relating the story from memory would allow for a more spontaneous signing sample than having to follow strictly the series of pictures and turning of pages. In addition, as has been noted by Ripich and Griffith (1988), having pictures present during the telling and retelling seemed to affect the storytellers' assumption of the listener's need for information. The shared context of the pictures precluded inclusion of certain information.

The specific instructions given to the subjects for the narrative discourse task are provided in Appendix A.

4.5.4 Standardised Tests to evaluate Cognitive Functioning

Cognitive tests were included in this research so as to provide a profile of each subject's cognitive functions. In addition it was anticipated that the results from these tests might provide information regarding the interrelationship between each subject's cognitive and linguistic functions. Lastly, examination of non-language visuospatial functions was included in the battery to attempt to investigate the relationship between non-language visuospatial processing and visuospatial processing in sign language.

The selection of the cognitive test battery used in this research was conducted with the assistance of a neuropsychologist. An individualised or flexible method of selection of cognitive tests was undertaken so as to assess the major areas of neuropsychological function and those functions of particular interest in this study. With a fixed battery there may be a danger of omitting assessment of a vital area of psychological function (Walsh, 1987). The particular protocol of tests was selected for the following reasons:

- The tests assess the major areas of psychological function.
- The protocol includes tests which assess neuropsychological functions of particular interest in this study.
- The battery includes measures commonly used in clinical practice.

- The tests have all been used previously in South Africa with neurological populations.
- The tests are easy and quick to administer.

Where necessary, tests were translated into SASL; however no adaptations or modifications to test items themselves were undertaken. All test instructions were given in SASL and all verbal responses were signed by the subjects.

The cognitive tests administered to each subject are presented in Table 4.9.

Table 4.9: Cognitive Test Battery translated into SASL

FUNCTION	TEST
AROUSAL	Orientation Attention: SAWAIS Digit Span Test
VISUOMOTOR FUNCTIONS	Grooved Pegboard Test SAWAIS* Digit Symbol Test
VISUOCONSTRUCTIONAL AND VISUOSPATIAL FUNCTIONS	Geometric Design Reproduction Test Rey Complex Figure Test Free Drawing SAWAIS Block Design Test Benton Facial Recognition Test
CALCULATION	SAWAIS Arithmetic Test
MEMORY	SAWAIS Digit Symbol Incidental Recall Test Recall of the Rey Complex Figure Test Paragraph Memory Test Rey Auditory Verbal Learning Test (signed version)

SAWAIS = South African Wechsler Adult Intelligence Scale

4.5.4.1 Arousal

Orientation

Each subject's appreciation of time, place and person was determined.

Attention

Attention was examined using the **SAWAIS Digit Span Test** (National Institute of Personnel Research (NIPR), 1956). Disorders of attentional activities, which include attention, concentration and conceptual tracking, may arise from lesions involving any point in the perceptual system (Worden, 1966, in Lezak, 1983). Impaired attention and concentration are the most common mental problems associated with brain damage (Lezak, 1978; Reitan and Klove, 1959, in Lezak, 1983). The simplest test of mental tracking is digit recall, or digit span, which merely tests how many bits of information a person can attend to at once and repeat in order (Lezak, 1983).

4.5.4.2 Visuomotor functions

The **Grooved Pegboard** and the **SAWAIS Digit Symbol Tests** (NIPR, 1985) were used to examine visuomotor functions in all subjects. The Grooved Pegboard is a manipulative dexterity test. The test requires more complex visual-motor coordination than most pegboards (Lafayette Instruments, USA). Visual-motor coordination for dominant and nondominant hands was measured. The Digit Symbol Test is probably the test most frequently reported as showing decrement with brain damage in various forms and locations. The responses are the end product of the integration of visual, perceptual, oculomotor, fine manual motor and mental functions. Some of the mental functions involved are attentional, planning and memory factors (Smith cited by Walsh, 1987).

4.5.4.3 Visuoconstructional and visuospatial functions

As discussed in Chapter Two, visuospatial relations and linguistic structure are intimately combined in sign languages (Poizner et al, 1987). Hence examination of the subjects' non-language visuospatial functions was undertaken in an attempt to determine the

relationship between their non-language visuospatial functions and their linguistic use of space in signing. The non-language visuospatial functions were examined using visuoconstructional and visuospatial tasks, discussed below.

Visuoconstructional functions

Tests assessing constructional performance were considered to be a necessary part of the battery as constructional functions combine perceptual activity with motor response and always have a spatial component (Lezak, 1983). Benton, 1969 (Lezak, 1983, p.32) notes that constructional disorders are disturbances "in formulative activities such as assembling, building, drawing, in which the spatial form of the product proves to be unsuccessful without there being an apraxia of single movements". Constructional functions includes two large classes of activities, drawing and building/assembling. The tendency for drawing and building disabilities to occur together is so variable that the two classes of activities need to be evaluated separately (Lezak, 1983). Hence the battery includes both drawing and assembling tasks.

Drawing tasks

Copying: **The Geometric Design Reproduction Test** (Nell, 1985) and the **Rey Complex Figure Test** were employed to assess visuoperceptual and constructional skills. The Geometric Design Reproduction Test consists of four designs commonly used in neuropsychological assessment (circle, square, diamond and Greek cross) and an additional design, a double-headed arrow. The Rey Complex Figure Test has proved to be an important neuropsychological tool and the clinical use of this test has been extensive (Boone, Lesser, Hill-Gutierrez, 1993; Duley, Wilkins, Hamby, Hopkins, Burwell and Barry, 1993; Rosselli and Ardila, 1989; Delaney, Prevey, Cramer and Mattson, 1992).

Free drawing: The subjects were required to draw a house and a bicycle.

Assembling

The **SAWAIS Block Design Test** (NIPR, 1956) was employed. Block design is generally accepted as the best measure of visuospatial organisation in the Wechsler scales. It reflects general ability to a moderate extent so that intellectually capable but academically or culturally limited persons frequently obtain their highest scores on this test. Block design scores tend to be lower in the presence of any kind of brain injury (Lezak, 1983).

Facial recognition

In addition to the assessment of visuoconstructional functions which contain a spatial component, the **Benton Facial Recognition Test** was included in the battery to assess the recognition of facial identity and to provide additional information concerning the subjects' visuospatial functions.

4.5.4.4 Calculation

Acalculia represents one of the most complex neuropsychological syndromes (Rosselli and Ardila, 1989). "An assessment of cognitive functions that does not include an examination of calculation skills is incomplete" (Lezak, 1983, p.498). Furthermore, given that the population group studied in this research was the learning disabled, inclusion of an arithmetic test was viewed as necessary in order to provide more information regarding each subject's particular learning disability. The **SAWAIS Arithmetic Test** (NIPR, 1956) was therefore administered to each subject.

4.5.4.5 Memory

Procedures for assessing learning and memory disorders are essential if an accurate clinical picture is to be gained. In general memory tests should indicate not only the severity of a disorder, but also the kinds of memory that are impaired (Mayes, 1986). "At a minimum, the memory examination should cover span of immediate retention; learning in terms of extent of recent memory; learning capacity and how well newly

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learned material is retained; and efficiency of retrieval of both recently learned and long stored information" (Lezak, 1983, p.414).

In this study the span of immediate verbal retention was assessed using the **SAWAIS Digit Span Test**. In addition incidental information on the duration and stability of the immediate verbal span for meaningful material was gained from the subjects' performance on the **SAWAIS Arithmetic Test** and the **Repeating Phrases and Sentences Subtest** from the BDAE.

A paragraph for recall, the **Paragraph Memory Test** (Nell, 1985), was used to examine learning and retention of meaningful verbal material. The Paragraph Memory Test is similar in length, syntactic and semantic complexity and number of items to Story B of the Wechsler Memory Scale (Brown, Wills, Yousefi and Nell, 1991). Recall was tested immediately and after a twenty minute delay. A signed version of the **Rey Auditory Verbal Learning Test** (RAVLT) was also employed as this test has been widely used in the assessment of memory disturbance in learning disabled populations (Mitrushina, Satz, Chervinsky and D'elia, 1991). The RAVLT has gained acceptance as a useful instrument in neuropsychological assessment due to its ease of administration and the information it provides regarding the integrity of encoding and retrieval processes, a learning curve, assessment of primacy and recency, interference effects, and a comparison of immediate versus delayed recall (Forrester and Geffen, 1991; Savage and Gouvier, 1992; DeLaney et al, 1992). Although as mentioned previously in Chapter 3, the inclusion of memory tasks with a selective or restricted reminding format allows for adequate separation of storage and retrieval skills, selective reminding formats were not included due to the scope of this research. Separation of these skills could be carried out at a later stage using a more fully comprehensive battery. The **Background Information Questionnaire** which was administered prior to all other testing provided information regarding the subjects' remote personal memory.

The **Digit Symbol Incidental Recall Test**, using Kaplan's method as described by Lezak (1983), was used to assess non-verbal recent memory (see Shuttleworth-Jordan and Bode, 1993). The **Rey Complex Figure Test** involves configural recall and retention.

4.6 DATA COLLECTION

As noted previously, a deaf adult native signer administered all tests in this study. This was done to ensure that the "code choice" used between the administrator of the tests and the subjects was that used between deaf-deaf individuals. As mentioned in Chapter One, deaf persons can sign quite differently with hearing persons than with other deaf persons, and it is not unusual for the deaf participant in a deaf-hearing conversation to switch away from true sign language to a more English-based form of signing (Lucas and Valli, in Lucas, 1988). Furthermore the involvement of deaf adult native signers in the transcription and scoring processes allowed for a more in-depth and accurate analysis of test responses.

The deaf adults for these tasks were chosen according to specified criteria. One was employed for administration, one for videorecording, three for transcription, three for judging and two for scoring. Intensive training was undertaken for all. Their relevant details appear in Table 4.10.

Table 4.10: Descriptive data pertaining to the deaf adults involved in test adaption, construction, administration, transcription, scoring and rating

	Test adaption and construction (2)		Test adminis-trator	Trans-criber	Transcriber & scorer (2)		Rater 1	Rater 2	Rater 3
Age	23	21	38	21	27	30	26	36	32
Sex	M	M	F	F	F	M	F	M	F
Deaf family members	deaf parents, deaf siblings	deaf parents, deaf siblings	deaf spouse, deaf children	deaf parents, deaf siblings	deaf spouse	deaf spouse	deaf spouse	deaf spouse	deaf spouse

4.6.1 Training in Test Administration

The deaf examiner received approximately fifty hours' training in the administration of the test battery. Training included administering the tests to nondisabled deaf adults. Some of the aspects focused on during training were the role of the examiner, the purpose and aim of each test, and familiarisation with the instructions, test items, and administration procedures of each test. Final proficiency was determined when the deaf examiner displayed a thorough understanding of and familiarisation with all test material, was able to give clear instructions and could follow the necessary test procedures with ease.

4.6.2 Data Collection Procedure

All tests were administered by the deaf examiner in the presence of the researcher. All testing conducted in this research was videotaped and later scored and analysed. The subtests of the BDAE and the Cognitive Test Battery were administered according to the manner prescribed in the test manuals. The instructions and administration procedures for the Formal Sign Language Tests are provided in Appendix A. The Narrative Discourse Samples were elicited by the deaf examiner.

All subjects were tested individually. The time taken to complete testing with each subject varied from six to eight hours and was divided into three or four sessions consisting of two hours each.

The tests were videotaped using a Ferguson Videostar camera. Technical issues which received particular attention were as follows:

Seating: The examiner and subject were seated fairly close together to allow for the use of only one camera, although in certain tests only the subject was videotaped. The chairs had no arms so as to avoid restriction of hand and arm movements.

Lighting: Extra lighting was found to be necessary to capture the signing and facial expressions clearly on videotape. A special background was necessary to avoid the effects of shadows.

4.7 TREATMENT OF DATA

The videotaped data were subsequently scored and analysed as follows.

4.7.1 BDAE, Formal Sign Language Tests and Cognitive Test Battery

Scoring of the BDAE Subtests, the Formal Sign Language Tests and the Cognitive Test Battery was undertaken by two deaf adult signers, in conjunction with the researcher, in all cases where a signed response was involved. The two deaf adult signers were employed so as to verify the signed responses. If the response did not involve signing scoring was undertaken solely by the researcher. Interpretation of the results of the subjects' performances on the Cognitive Test Battery was undertaken with the assistance of a neuropsychologist.

Scoring of the BDAE and the Cognitive Test Battery was carried out according to the manner prescribed in the test manuals. Scoring of the Formal Sign Language Tests was carried out according to the scoring procedure established for each test; scores are expressed in percentages.

4.7.2 Narrative Discourse Task

4.7.2.1 Transcription and glossing of the narrative discourse samples

Transcription of the videotaped discourse samples was undertaken by a deaf adult signer. Transcription reliability was determined as detailed in section 4.7.3 below. Unintelligible utterances and false starts were marked in the transcript but excluded from the analysis. The following conventions, similar to those described by Liddell (1980), were used to gloss SASL utterances.

- Individual signs are written in capital letters.
- When more than one word is required to translate a single sign, the words are connected with hyphens (e.g. LONG-AGO).
- If two signs are signed as a compound, the two words are connected with a superscript arc (e.g. FEEL$^{\frown}$LIKE).
- Reference to pronouns is transcribed as follows:

  First person singular (I) - PRO.1

  Second person singular (you) - PRO.2

  Third person singular (he, she, it) - PRO.3

  First person plural (we) - PRO.1 pl., etc.

  The same applies to the pronoun self, thus "yourself" = SELF 2, and to the possessive marker, thus "its", "hers", "his" = POSS.3.
- When a verb indicates its subject by means of its movement, location or orientation with respect to a given index (location in space), that subject is shown in raised brackets preceding the sign, using an "X" to indicate reference to an index and lower case pronominal notation to identify that index, e.g.:

  $^{(X:\ boy)}$WALK, "the boy walks".

  An object or adverb of place will be shown in raised brackets following the sign:

  WALK$^{(X:\ home)}$.
- If a verb is inflected for aspect, raised brackets are also used. The notation "I" indicates an inflection of the sign.
- If a nonmanual signal (i.e. a specific facial expression, head position or movement, body position or movement, or a specific combination of these) occurs throughout a sign sequence such as WHAT THESE THINGS, this is symbolised as, for example,

  $\underline{\qquad\qquad\qquad\qquad\qquad\quad}^{q}$
  WHAT THESE THINGS

  The following notation is used for these nonmanual signals: q = question, n = negative, a = adverbial, and l = lexical function.
- Multichannel signs are written in quotes, e.g. "FIS".
- Free English translations of SASL sentences are written in quotes in English in lower case letters.

4.7.2.2 Methods of analysis of narrative discourse productions

To prepare the transcribed data for analysis, false starts and unintelligible utterances were deleted. The basic unit for segmenting the data was an "event". For the purposes of this analysis an event was defined as a change in place or character. For each subject the total number of words and events was calculated.

As a result of the scope of this research the narrative discourse samples were only analysed with respect to suprasentential (macrolinguistic) organisation and adequacy and not intrasentential (microlinguistic) adequacy (Glosser and Deser, 1990). Coherence and cohesion were taken as measures of suprasentential organisation. Coherence has been used to characterise conceptual organisational aspects of discourse at the suprasentential level. Cohesion refers to specific relations of meaning between elements within discourse. While the effect of coherence is sustained by an overall thematic unity, it is expressed linguistically through cohesive devices. Cohesion does not encompass as broad a scope of suprasentential meaning relations as coherence, but it appears to capture intersentential relations beyond the microlinguistic level (Glosser and Deser, 1990).

Both coherence and cohesion relate to the well-formedness of text: coherence, in terms of the plausibility, conventionality and conclusiveness of text, is a general cognitive concept, while cohesion refers to linguistic devices such as anaphora and reference, which produce coherence (Ulatowska et al, 1981).

Coherence

In this study the narrative productions were analysed according to the narrative structure elements proposed by Labov (1977) as constituting a well-formed narrative. This method of analysis was selected as it has been used by many other researchers in the evaluation of disordered discourse in other neurogenic groups and hence might allow for a comparison of results.

According to Labov (1977) a fully formed narrative consists of the following six elements:

- abstract - one or two clauses summarising the whole story
- orientation - at the outset the time, place, persons and their activity or the situation is identified
- complicating action - the sequence of events presented chronologically
- evaluation - devices used to express the narrator's feelings about the characters and events
- resolution - a statement which reflects the final events or ends the experience
- coda - a signalling by the narrator that the narrative is finished.

Preservation of the above-mentioned narrative structure elements in each subject's narrative discourse production was determined. Events were classified according to five of the six categories. Evaluation was excluded from the analysis of narrative structures as evaluation frequently occurs as part of an event throughout the discourse production. However, as noted by Labov, 1972 (Ulatowska et al, 1981), evaluation is one of the very significant components of narrative discourse. In the absence of evaluative expressions, narratives become devoid of interest. Since evaluation is one of the very important components of narrative discourse and plays an important function in the well-formedness of narrative a separate analysis of evaluation was undertaken.

Analysis of evaluation in signed discourse

To the best of my knowledge no theoretical framework for the analysis of evaluation in signed discourse has been developed. Hence in this study a method of analysis of evaluation, based on that proposed by Labov (1977) for a spoken language, English, was adopted. The four major categories proposed by Labov (1977), intensifiers, comparators, correlatives and explications, were used in the analysis. Numerous subtypes are found within each category. Modifications were made regarding the subtypes of these categories. In attempting to analyse the evaluative elements in the signed discourse productions it became evident that there were some devices used in evaluation which appear to be particular to sign language and others particular to spoken languages. In the category of "intensifiers" an additional subtype "multi-channel signs" was added and

"expressive phonology" was replaced with "nonmanual behaviours". The subtype "multichannel signs" was added as these signs were found to operate as evaluative devices. In the category of correlatives, the subtypes "be+ing" and "-ing without be" were excluded as they are not used in SASL. A ritual utterance, "thumbs up", conveying various meanings in English such as "OK", "good", "nice", "fine", "great", was used frequently by the pilot subjects and subjects in this research. The categories and their subtypes used in this analysis are presented in Table 4.11a.

The number of evaluative expressions used in each subtype was calculated and expressed as a percentage of the total number of evaluative expressions used by each subject. In addition the total number of evaluative expressions relative to the total number of words was calculated for each subject.

Cohesion

In this study an investigation of the use of "spatial referencing" and conjunctions to create cohesion in SASL text was undertaken. As noted by Halliday and Hasan (1976), referential and lexical types of cohesion are among the most commonly occurring in normal narrative discourse.

Spatial referencing

Investigation of the use of spatial referencing as a cohesive device in sign language discourse is fairly rare. To the best of my knowledge this is the only study which looks at signed narrative discourse productions of deaf learning disabled subjects, and in particular the use of referencing within such discourse.

Observations made of the pilot narrative discourse samples indicated that combinations of the mechanisms discussed by Winston (1991) (see Chapter Two) were used. However spatial referencing appeared to fall into four major categories: performatives (role playing), articulating the sign for the referent, agreement verbs and indexing the pronominal. Definitions and examples of the referencing categories employed are shown in Table 4.11b.

Table 4.11a: Categories and subtypes used in the analysis of evaluation

CATEGORY	SUBTYPE
INTENSIFIERS	Gesture Non-manual features Quantifiers (e.g."all") Repetition Multichannel signs Ritual utterance (thumbs up)
COMPARATORS	Negatives Futures Modals Questions Quasimodals Imperatives Superlatives Comparatives
CORRELATIVES	Double Apposatives Double Attributives
EXPLICATORS	

Table 4.11b: Categories used in the analysis of spatial referencing

ARTICULATING THE SIGN FOR THE REFERENT	
PERFORMATIVES	Performatives show the action and persona of a speaker (Winston, 1991).
VERB AGREEMENT	The system of verb agreement is essentially spatialised as it moves between loci in specifying grammatical relations. The same signs in the same order, but with a reversal in direction of spatial endpoints of the verb, may indicate different grammatical relations (Bellugi, 1988).
INDEXING	In signed discourse pointing again to a specific locus clearly refers back to a previously established nominal (Bellugi, 1988).

Analysis involved identifying and noting the frequency of occurrence of spatial referencing within these four categories. The score within each category was then expressed as a percentage of the total number of spatial references made throughout the narrative discourse production by each subject. Indexing was further divided into two subcategories, indexing during narration and indexing pronominals during role playing. Articulating the sign for the referent was also divided further into three subcategories: providing the signed nominal during role play, signing the nominal immediately prior to role playing and signing the nominal during narration.

Halliday and Hasan (1976) note that cohesion is a general text-forming relation, or set of such relations, which, when incorporated within a sentence structure, are subject to certain grammatical restrictions. The cohesion across sentences is more striking and the meaning more obvious as they are the only source of texture, whereas within the sentence there are the structural relations as well. However the cohesive relations are the same whether they occur within the same sentence or not.

The analysis of referencing carried out in this study was conducted both within and across sentences. Referencing within sentences was included as pointing again to a specific locus clearly refers back to a previously established nominal both within and across sentences (Bellugi, 1988). The analysis focused on the distribution of spatial referencing across the above-mentioned four categories and an attempt at the identification of trends of usage of spatial references among the nondisabled and learning disabled was made. An analysis of the nature of the disruption of spatial referencing within the four categories is an area in which further research could be conducted. This was not undertaken as no previous research has been conducted on spatial referencing in SASL among nondisabled or language impaired deaf persons on a sentence or discourse level. Moreover there is little documented research on the use of spatial referencing in discourse in other signed languages.

Conjunctions

The use of conjunctions as a cohesive device in ASL has been noted by Winston (1991). Analysis of such use, or the absence or disruption of use, in SASL narrative discourse

productions would provide interesting comparable data to those found in ASL texts. In addition Halliday and Hasan (1976) note that where referencing is a grammatical cohesive device, conjunctions are mainly grammatical with a lexical component. The analysis of the usage of conjunctions as a cohesive device involved identifying the type of conjunctions used and the frequency of their usage within each subject's narrative discourse production.

Nonmanual features

Analysis of the use of nonmanual features in each subject's narrative discourse production was also undertaken. Due to the scope of the study, however, the analysis of nonmanual behaviours was restricted to their role in questions, negation, adverbials, intensifiers and multi-channel signs. These nonmanual features were selected as between them they tap the use of nonmanual behaviours on the three different levels, phonological, morphological and syntactical.

The language samples provided by the narrative discourse productions were analysed for nonmanual features as follows. The presence of nonmanual behaviours accompanying any signed utterance was marked by the three transcribers on all transcriptions. The presence or absence of nonmanual behaviours performing a grammatical function - marking questions, negation and adverbials - and a lexical function - in the form of multi-channel signs - was noted for each subject.

The use of nonmanual behaviours by each subject was also rated by the three raters of coherence and cohesion; for this, each subject's use of nonmanual behaviours in the narrative samples was rated on a three-point scale representing poor, average and effective use.

Content and clarity ratings

In addition to the above objective analyses, a rating system was devised to evaluate the "content" and "clarity" of the narrative discourse productions. As had been suggested

by Ulatowska et al (1983) "content" can be identified as a rough measure of coherence and "clarity" as a rough estimate of cohesion.

The content of the narrative discourse productions was rated using a three-point scale in response to specific questions about the information contained in the narrative. Examples of the questions are "Do you know what is happening in this story?" and "Is this story accurate in terms of the stimulus material?" The clarity of language was rated on a three point scale in response to questions regarding the comprehensibility of the language used and the use of space and referencing in the discourse productions. Examples of the questions posed are "How comprehensible is the language of the story?" and "Was it clear to whom the signer was referring throughout the story?" Final scores were obtained for content and clarity for each subject by adding the scores from the individual questions.

Eight visual cassettes were prepared with the narrative discourse productions. The subjects were randomised and identified by number only. Three deaf adult signers rated the discourses. The conceptual distinction between the content and clarity of language was explained to them. They were told that a story can be evaluated "high" with regard to content but may contain unclear language and vice versa. After practising with sample data, the raters independently rated each narrative discourse.

4.7.3 Measures of Reliability

"Reliability should be a central concern because it is a necessary, although not sufficient, prerequisite to the validity of scores" (Strong and Shaver, 1991, p.96). If assessment is not reliable, that is, if the results of measurement are not consistent and repeatable, then the scores lack meaning (Strong and Shaver, 1991). Hence measures of reliability concerning the transcriptions, the scoring of referencing and evaluation and the ratings of clarity and content were undertaken. It is hoped that the measures of reliability used in this study will provide a linguistic contribution to the study of sign language, as in general there is little mention of measures of reliability and validity regarding testing material in previous studies of sign language.

Interrater reliability for transcriptions was determined as follows. Two additional transcribers independently transcribed three randomly selected narrative discourse samples. Reliability scores were obtained by dividing the total number of agreements by the total number of agreements and disagreements for each narrative sample. The interrater reliability figures are represented in Table 4.12. The agreement percentages were considered to be high, especially considering that the transcriptions involved transcribing from a signed sample into a written sample and there is not always a one sign to one word equivalent.

Table 4.12: Transcription reliability: Agreement percentages

	Agreement	95% Confidence Interval
Transcript 1		
T1 & T2	85,21%	,80 - ,90
T1 & T3	90,85%	,87 - ,95
Transcript 2		
T1 & T2	90,70%	,86 - ,96
T1 & T3	90,29%	,85 - ,95
Transcript 3		
T1 & T2	85,98%	,83 - ,90
T1 & T2	90,85%	,85 - ,95

All scoring of referencing and evaluation in the objective analysis of the narrative discourse productions was completed by the researcher. To ensure reliability of the scoring another speech pathologist familiar with sign language scored 20% of the utterances, randomly selected, from each of the six transcripts (MacLachlan and Chapman, 1988). Prior to scoring the frequency and types of evaluative and referential devices, discussion and practice in identifying them, according to the categories outlined in this research, were undertaken by the second scorer. Practice trials were carried out on samples which were not included in the final samples used to determine interscorer reliability. Discussion and practice trials were undertaken to attempt to ensure consistency between scorers on the particular evaluative and referential devices being identified. The total number of agreements was divided by the total number of

agreements and disagreements for each sample. For technical reasons, as the agreement between scorers was high, the Pearson Product Moment correlation coefficient formula was employed rather than other interscorer agreement formulae. Pearson Product Moment correlation coefficients were computed and statistical significance was determined.

Three raters were employed to rate content and clarity of the narrative discourse productions. Agreement among raters was again found to be high, so correlations were computed for each subject's content and clarity ratings, using the Pearson Product Moment Correlation. In addition correlations of the scores for each rater on each question were determined. Means and standard deviations were calculated.

In this chapter, the methodology adopted in this study has been described. In the next chapter the results for the control and learning disabled subjects on the test batteries will be presented.

CHAPTER FIVE
RESULTS AND DISCUSSION

In this chapter the results of the learning disabled deaf subjects and the control subjects on the test batteries described in the previous chapter are presented. A description of the learning disabled deaf subjects' linguistic and cognitive functions is undertaken. Trends are highlighted, but also individual differences, considering the heterogeneity of the learning disabled population. Furthermore an attempt is made to identify and describe the relationship between the subjects' linguistic and cognitive functions. Finally, the subjects' performance on cognitive and linguistic functions in this study is compared to that of previous research.

5.1 RESULTS OF THE SIGN LANGUAGE TEST BATTERIES

5.1.1 Standardised Tests of the Boston Diagnostic Aphasia Examination (BDAE)

The results of the tests administered from the BDAE for all subjects are displayed in Figures 5.1 and 5.2. These are presented on z-score profiles, which are provided by the BDAE for a variety of language subtests and standardised for a large group of hearing aphasic patients (Goodglass and Kaplan, 1983). The position of the raw score on its horizontal line may be read off as a z-score from the scale at the top and bottom of the page. The z-score provides the deviation above or below the mean ($z = 0$) in standard deviation (SD) units, and represents the mean score of hearing aphasic patients for each task.

The profiles show a general picture of some of the aspects of the subjects' language behaviour. In this study the z-score profiles were merely used as guidelines when comparing the results of the LDD subjects relative to each other, the matched controls, hearing aphasics and the deaf subjects from Poizner et al's (1987) research on the BDAE subtests. As noted by Bates, Wulfeck and MacWhinney (1991), adaption and norming of standard tests like the BDAE are not the same thing. They advise caution when relying on standardised scores from the "same" aphasia test across languages as there is no way of determining whether the "same" score means the "same" thing in English and in this case SASL.

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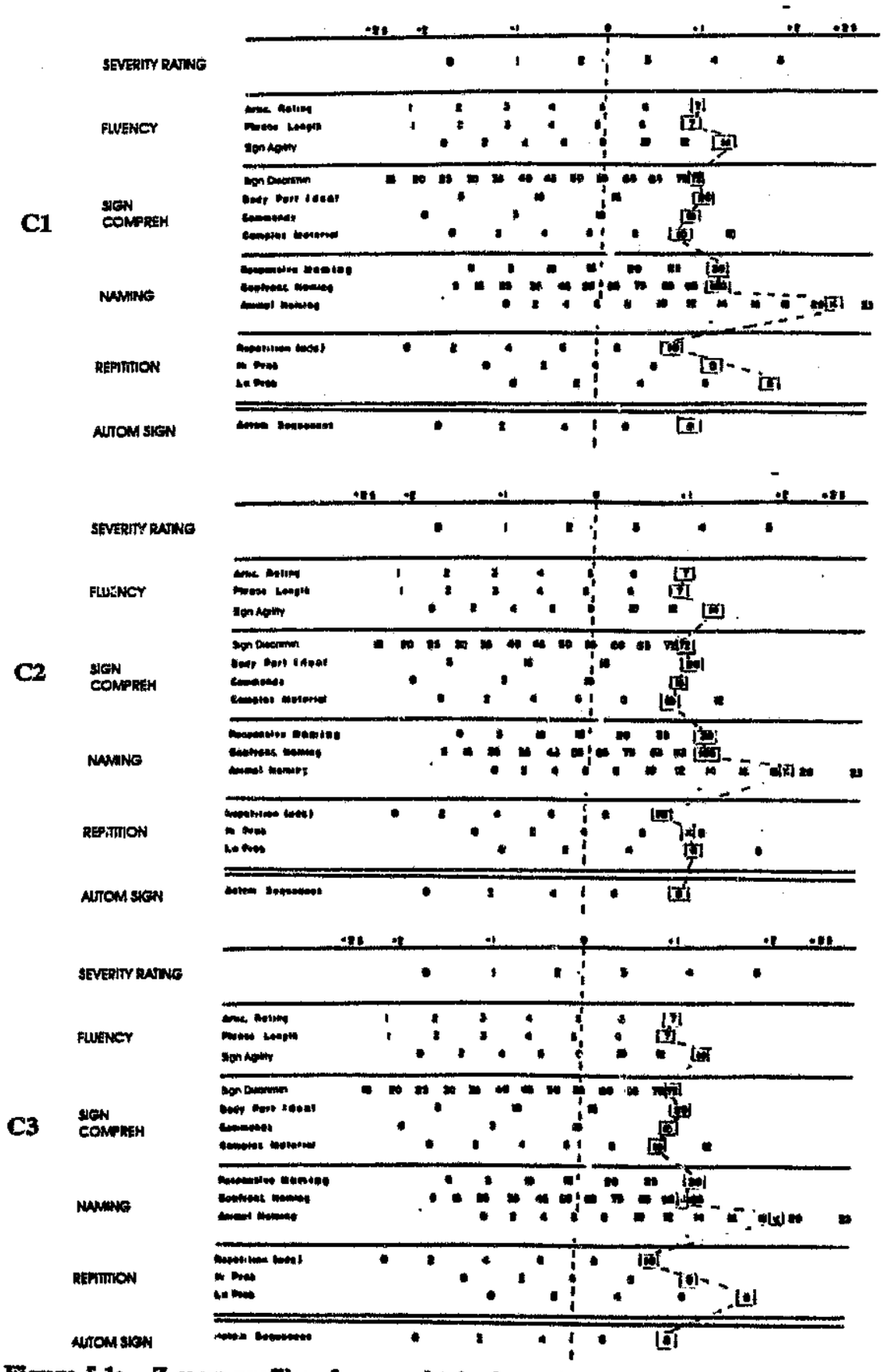

Figure 5.1: Z-score profiles of scores obtained on subtests of the BDAE by the control subjects

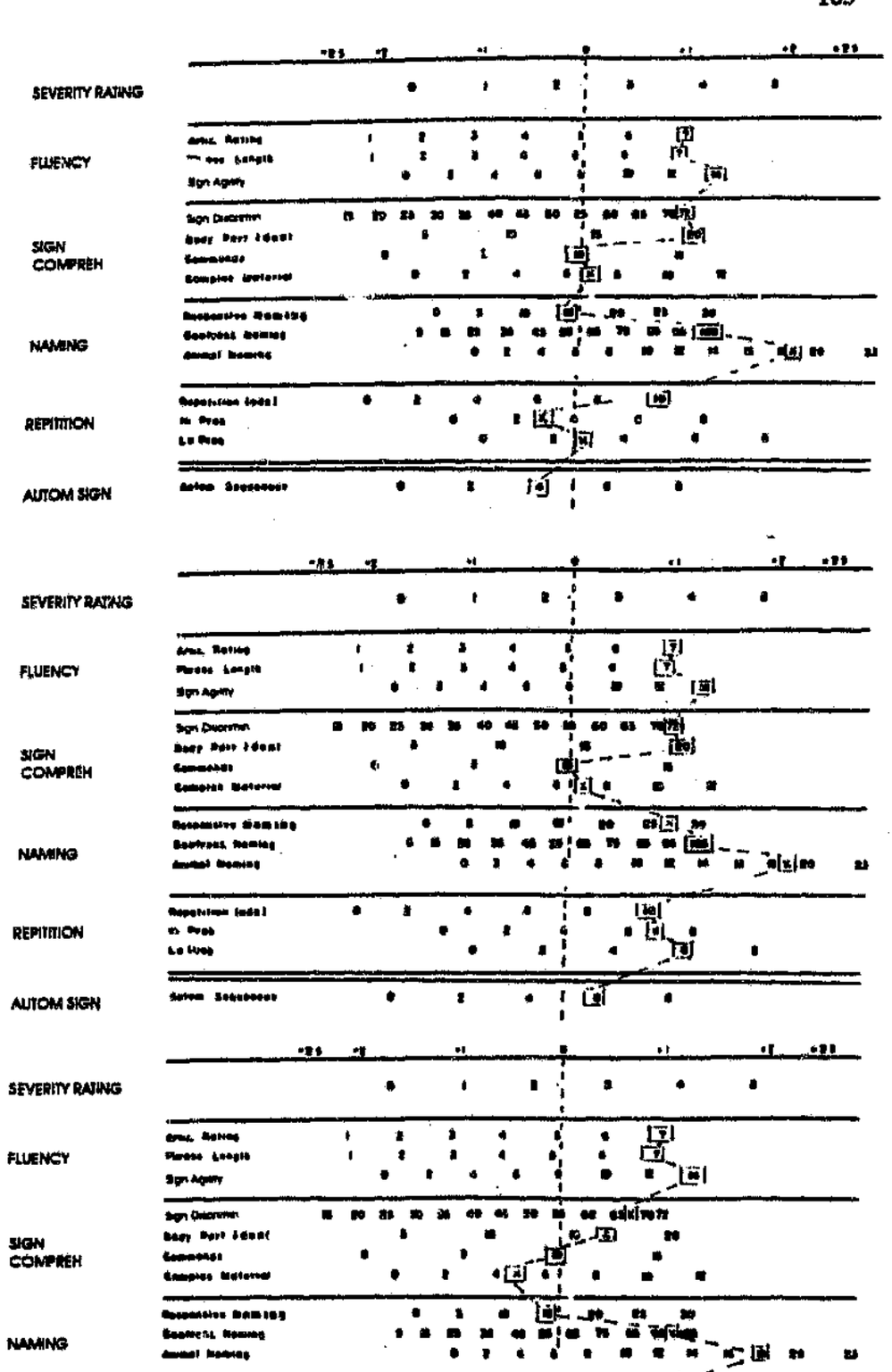

Figure 5.2: Z-score profiles of scores obtained on subtests of the BDAE by the LDD subjects

5.1.1.1 Fluency

As can be seen from Figures 5.1 and 5.2 all control and learning disabled subjects presented with fluent signed output. Sign fluency was based on three subtests: a rating of ease of sign articulation, a measure of the length of sign phrases in spontaneous signing, and a test of sign agility requiring rapid serial repetitions of single signs that varied in formational complexity. All subjects performed well on the test of signed agility and displayed an ease in sign articulation. It is however felt, as mentioned in Chapter Four, that further refinement of this test is needed.

5.1.1.2 Sign comprehension

As discussed in Chapter Four, the comprehension subtests measure for vocabulary, the capacity for information of increasing length and intellectual grasp.

The results of these subtests revealed that whilst the three control subjects have preserved comprehension in Sign Language all three LDD subjects have a deficit in the comprehension of Sign Language. As can be seen in the profiles, the deaf control subjects obtained 100% for the **Sign Word Discrimination, Body Part Identification**, and **Commands** subtests. None of the control subjects, however, obtained 100% for the Complex Ideational subtest, yet they all obtained high scores approximately 1 SD above the mean. In comparison, the three learning disabled subjects revealed deficits in comprehension especially when the complexity and length of information was increased. LDD1 and 2 demonstrated no difficulties in the subtests assessing comprehension of vocabulary (Sign Word Discrimination and Body Part Identification subtests). However they performed poorly on the Commands and Complex Ideational Material subtests, both obtaining raw scores of 10 and 7 respectively. LDD3 showed more marked impairments in sign comprehension than LDD1 and 2. Although he obtained the same raw score of 10 for the Commands subtest, he also displayed some difficulty in comprehension of vocabulary and he showed a more notable deficit on the Complex Ideational Material subtest, obtaining a raw score of 5. Using the z-score profile as a guideline, the raw scores obtained by the LDD subjects for the Commands and Complex Ideational Material subtests fell around the mean for hearing aphasic patients and approximately 1 SD below

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the scores of the matched controls. LDD3's low score of 5 for the Complex Ideational Material subtest fell half an SD below that of the mean for hearing aphasic patients and 1½ SDs below the matched controls.

5.1.1.3 Signed expression

Naming Subtests

Three naming subtests, **Responsive Naming, Visual Confrontation Naming** and **Animal Naming,** were employed to assess the subjects' naming abilities. The control subjects and LDD2 performed well on all three subtests. Although LDD1 and 3 performed well on the Visual Confrontation and Animal Naming subtests they obtained low scores on the Responsive Naming subtest. They obtained raw scores of 15, which is slightly below the mean for hearing aphasic patients, and slightly more than 1 SD below the matched controls. Goodglass and Kaplan (1983) note that when the z-score for performance on this test is much below that for Visual Confrontation Naming it is usually due to impaired auditory comprehension, in this case comprehension of sign, and is indicative of poor verbal associative skills. In addition Goodglass and Kaplan (1983) state that Responsive Naming forms one of the three subtests outside the comprehension cluster which relies on comprehension of auditory input, in this case signed input.

Repetition

This involved two subtests: **Repetition of Words** and **Repeating Low and High Probability Phrases and Sentences.** Both subtests involved a signed stimulus and required a signed response. All subjects, both control and learning disabled, obtained 100% for the Repetition of Words subtest. No paraphasic or articulatory errors were found. In the task involving repetition of phrases and sentences, the control subjects and LDD2 performed well; LDD1 and 3, however, showed much difficulty on this task. LDD1 obtained a raw score of 3 for the repetition both of high probability and low probability phrases and of sentences. Similarly LDD3 obtained a raw score of 4 and 3 for high probability and low probability phrases respectively. Again using the z-score profile as a guideline, the scores obtained by LDD1 and 3 on the high and low probability phrases fell around the mean for hearing aphasic patients and approximately 1 SD below the control subjects for the high probability phrases and approximately 2 SDs

below for the low probability phrases. Neither LDD1 nor LDD3 presented with articulatory or paraphasic errors, their errors rather being characterised by omissions.

Automatised Signing

The subtest of **Automatised Sequences** was used to assess automatised signing. All the control subjects obtained 100% on this subtest and showed no difficulty in reciting the sequences of the days of the week, months of the year, letters of the alphabet and numbers 1-21. In contrast the learning disabled subjects demonstrated much difficulty on this task. LDD2 obtained a raw score of 6 and LDD1 and 3 both obtained the low raw score of 4. LDD2's results fell slightly above the mean for hearing aphasic patients and approximately 1 SD below that of the matched control. On the other hand LDD1 and 3's scores fell below the mean and approximately 1½ SDs below that of the matched controls. LDD1, 2 and 3 all showed perseverative repetitions of words and word sequences and indicated problems with the sequential recall of automatic sequences.

5.1.1.4 Rating-scale Profiles

As discussed in Chapter Four, rating-scales provided by the BDAE were used for an assessment of the subjects' spontaneous natural signing according to six aspects of sign production (melodic line, phrase length, articulatory agility, grammatical form, paraphasias in running sign and sign finding) and in sign comprehension. As noted in Chapter Four, five of the six rating-scales are seven-point scales in which a score of 7 represents normal and a score of 1 maximally abnormal language characteristics. For the sixth scale, sign finding ability, both extremes reflect deviant language production, with normal performance represented in the middle of the scale. The rating-scale profiles for the LDD and control subjects are represented in Figures 5.3 and 5.4.

As can be seen from these figures all subjects presented with normal melodic line (phrasal groupings of signs), normal phrase length (seven or more occasional uninterrupted sign runs), normal articulatory agility, as indicated in their fluent signing, and a normal amount of variety of grammatical forms. The ratings involving the presence of paraphasia in running sign showed that LDD2 and 3 produced numerous paraphasias. These were noted in the form of both semantic and neologistic errors. LDD2 obtained

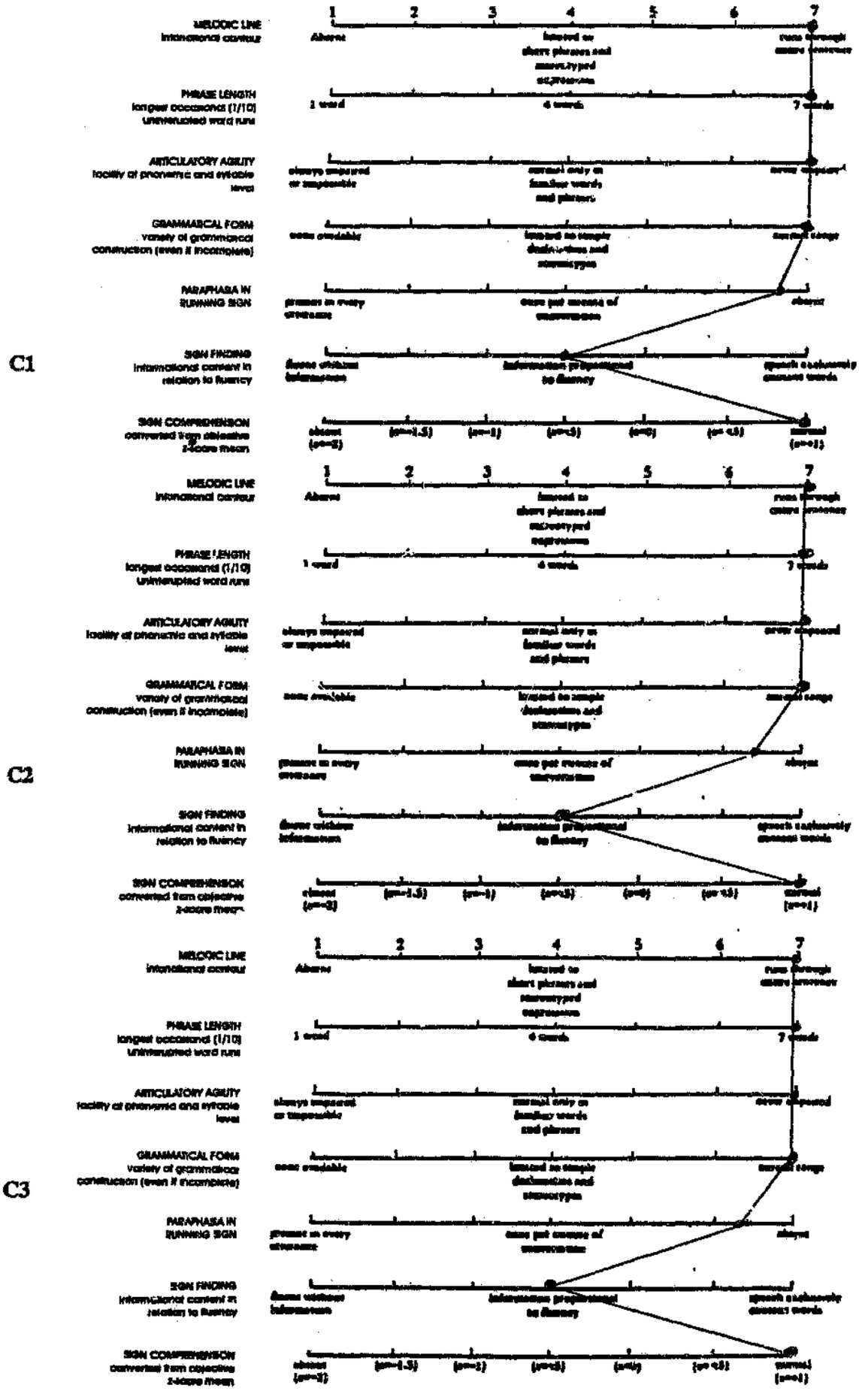


Figure 5.3: Rating-scale profiles of sign characteristics from the BDAE for the control subjects

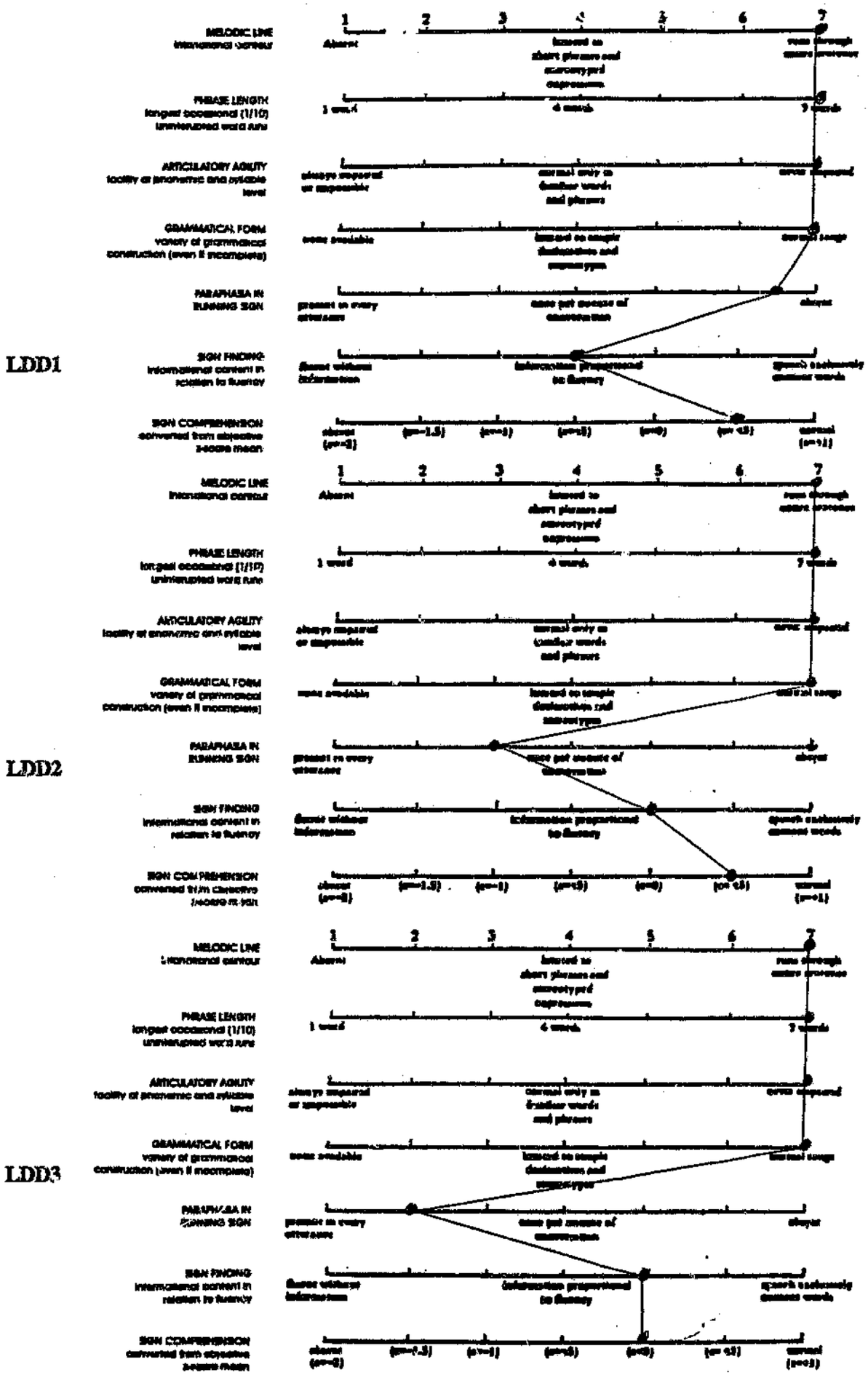


Figure 5.4: Rating-scale profiles of sign characteristics from the BDAE for the LDD subjects

a rating of 3, indicating that paraphasic errors occurred more frequently than one in every minute, but less than one in every utterance. LDD3 obtained the low rating of 2, indicating that a paraphasic error occurred in nearly every utterance. Although LDD2 and 3 produced numerous paraphasic errors in running sign they produced no paraphasias in one-word responses, as was noted in the subtests of the BDAE. All other subjects produced few paraphasias, obtaining a rating of 6 on the rating scale. Figures 5.3 and 5.4 shows that LDD2 and 3 differ from LDD1 and the control subjects in sign finding, the informational content of signs in relation to fluency. LDD2 and 3 both produced a higher proportion of low information words to substantives and specific action words than the other subjects, reflecting fewer content signs within their otherwise fluent and grammatically signed discourse samples. LDD1 and the control subjects obtained a rating of 4 indicating the estimation of the proportion of specific nouns and verbs to be just appropriate to the fluency level. On the seventh rating scale, that of comprehension, the rating is the mean z-score of the four comprehension subtests of the BDAE. The scores obtained by LDD1 and 2 fell half an SD below that of the controls, whilst LDD3's score was 1 SD below that of the controls and half an SD below that of LDD1 and 2.

In summary, all control subjects showed no deficits on the comprehension or expressive subtests of the BDAE. In addition, as was determined on the rating scale profiles, no deficits were observed in their spontaneous signing. On the other hand the three LDD subjects revealed a comprehension deficit in sign language, with LDD3 showing a more marked deficit. LDD1 and 3 presented with a deficit in responsive naming, which is indicative of a problem in verbal associative skills, and they also presented with difficulties in repeating phrases and sentences. All three LDD subjects presented with a deficit in automatised signing, with LDD1 and 3 showing a more marked deficit. According to the results from the Rating Scale Profiles, all three LDD subjects presented with fluent grammatical signing; however LDD2 and 3 revealed deficits in their spontaneous signing in the form of paraphasic errors and the reduced amount of informative words relative to their level of fluency.

5.1.2 Formal Sign Language Tests

A range of structural tests of South African Sign Language was administered to all subjects. These included assessing processes at a phonological and a morphological level, aspects of spatialised syntax and the perception of facial expressions used for linguistic purposes in sign. All control subjects performed well across the range of formal sign language tests, obtaining scores above 85%, with the majority of scores ranging from 90% to 100%. However the results of the learning disabled subjects on these tests varied between subjects and across tasks. The performance of all subjects in the formal sign language tests is presented in Table 5.1.

Table 5.1: Scores obtained on the formal sign language tests (percentages)

	C1	C2	C3	LDD1	LDD2	LDD3
SASL PHONOLOGICAL PROCESSING TESTS						
Rhyming	86,6	86,6	100	73,33	93,33	86,6
Decomposition	93,33	93,33	93,33	100	100	80
SASL MORPHOLOGICAL PROCESSING TESTS						
Comprehension of noun/verb distinction	91,7	100	91,7	58,3	83,33	75
Expression of noun/verb distinction	95	90	88,88	78,95	85	87,5
SPATIALISED SYNTAX TESTS						
Nominal establishment	100	90	100	80	70	90
Verb agreement (fixed framework)	100	90	100	100	66,67	80
Verb agreement (shifting reference)	100	92,86	100	42,86	0	0
GRAMMATICAL FACIAL EXPRESSION TESTS						
Name the grammatical facial expression	93,75	87,5	93,75	87,5	56,25	37,5
Choose the correct facial expression	87,5	100	93,75	100	93,76	56,25
Same/different facial expression	100	100	100	100	100	100

5.1.2.1 SASL phonological processing tests

Two tests, the **Rhyming Test** and the **Decomposition Test**, were employed to assess the subjects' ability to decompose signs into parts. All subjects performed well on these tasks, obtaining percentages above 85%, with the exception of LDD3's score of 80% on the Rhyming Test and LDD1's score of 73,3% on the Decomposition Test. It is believed that these lower scores may be due to factors such as a slowness to develop the correct response set and lack of concentration rather than an inability to decompose signs into

parts. This argument would be supported by the high scores of 100% obtained by LDD1 on the Rhyming Test and 86,6% obtained by LDD2 on the Decomposition Test.

5.1.2.2 SASL morphological processing tests

The expressive use of noun/verb pairs which are derivationally related was assessed using the two tests Comprehension of Noun/Verb Distinction and Expression of Noun/Verb Distinction.

On the **Comprehension of Noun/Verb Distinction Test**, the normal controls all obtained above 90%. LDD2 and 3 obtained slightly lower scores of 83,3% and 75% respectively, whilst LDD1 obtained a relatively low score of 58,3%. The results for LDD1 and perhaps LDD 2 supports the findings on the comprehension subtests of the BDAE, which suggest a comprehension deficit. These results would indicate difficulties in the comprehension of signs of a nonspatial derivational type.

On the **Expression of Noun/Verb Distinction Test**, in which the subject is required to provide the signs for ten noun/verb pairs, all subjects except for LDD1 obtained scores above 85%. LDD1 obtained a slightly lower score of 78,95%, which may provide converging evidence of a difficulty in both comprehension and expression of signs of a nonspatial type.

5.1.2.3 Spatialised syntax tests

Three subtests were used to evaluate the processing of spatialised syntax. Firstly, the **Nominal Establishment Test** assessed the subject's perception and memory of nominals that have been assigned a specific locus in the horizontal signing space in front of the signer. The control subjects and LDD3 scored 90% and above on this subtest. LDD1 and 2 obtained slightly lower scores of 80% and 70% respectively.

The second and third subtests assessed the processing of verb agreement. In the second subtest, **Verb Agreement with a Fixed Framework**, all the control subjects acquired scores from 90% to 100%. LDD1 also performed well on this subtest, scoring 100%.

However, LDD3 obtained a slightly lower score of 80%, and LDD2 a low score of 66,67%.

In the third subtest, **Verb Agreement with a Shifting Reference**, the additional ability to shift the spatial framework in order to process correct grammatical relations is required. All the control subjects exhibited good performance on this subtest, obtaining high scores of 92,8% and above. However the learning disabled subjects showed much difficulty in this task. LDD1 obtained a relatively low score of 42,9% and both LDD2 and 3 failed all test items repeatedly, despite many attempts and much explanation from the examiner.

In summary, it can be seen that the normal controls displayed no difficulties with any of these structural subtests. However LDD1, 2 and 3 each showed difficulties on some of these subtests. Some of these results support the findings of the comprehension subtests of the BDAE, which indicated a comprehension deficit for all the LDD subjects.

LDD1 showed difficulties on the Comprehension of Noun/Verb Distinction Test and the Verb Agreement with a Shifting Reference Test, which would indicate that his comprehension deficit also involves difficulties in processing signs of a non-spatial type and in processing spatial relations when there is a shift in reference.

LDD2's poor performance on both verb agreement tests indicates an impairment in processing spatialised syntax within a fixed and shifting referential framework.

LDD3's inability to complete the test for verb agreement with a shifting reference would suggest a severe deficit in processing spatialised syntax when it involves a transformation of spatial relations, whilst his slightly lower score on the Comprehension of Noun/Verb Distinction may suggest some difficulty in processing derivationally related noun/verb pairs.

5.1.2.4 Grammatical Facial Expression Tests

Three subtests were used to assess the identity and perception of facial expressions which carry linguistic information in sign language. The first subtest, **Name the Grammatical Facial Expression Test**, requires the subject to identify and name one of four facial expressions. The second subtest, **Choose the Correct Facial Expression**, requires the subject to discriminate between four different facial expressions and identify the one that depicts the grammatical information named by the examiner. In the third subtest, **Same/Different Facial Expression Discrimination Test**, the subjects are required to discern whether two pictures of the same signer display the same of different facial expressions.

All control subjects and LDD1 obtained scores above 85% for all three subtests. All subjects including the learning disabled deaf subjects obtained 100% for the third subtest, Same/Different Facial Expression Discrimination Test. It is believed that the format of the test, using only two pictures, in two dimensions, at each presentation, is obviously not sufficiently sensitive in tapping difficulties in the recognition and discrimination of facial expressions. This argument would be supported by LDD3's failure on the **Benton Facial Recognition Test** (see section 5.3.3 below), which would indicate a deficit in the recognition of facial identity, despite his score of 100% for this subtest.

However much difficulty was demonstrated on the first of these three subtests by LDD2 and on the first and second subtest by LDD3. On the first subtest LDD2 obtained a low score of 56,25%. In this test he was required not only to identify but also to name the presented facial expression.

LDD2's performance on the Grammatical Facial Expression Tests may prove to be particularly interesting and may provide support to the findings reported by Bowers and Heilman (1984, in Rapscak et al, 1989) and to those reported by Rapscak et al (1989). Bowers and Heilman described a right hemisphere brain damaged patient who performed normally on neutral facial discrimination and recognition tasks and was able to judge whether two photographs of the same person depicted identical or different facial emotions, but was impaired in naming and pointing to facial expressions. The authors

suggested that this patient's deficit could be accounted for either by an anomia for facial expressions induced by a visual-verbal disconnection, or by an associative agnosia for facial affect leading to an inability to recognise facial expressions. The authors of the study were unable to determine whether the patient presented with an anomic or an agnosic type of defect as one needs to test performance on tasks that require adequate recognition of facial expressions but do not necessitate explicit verbal learning. Rapscak et al (1989) described a patient with right hemisphere damage who demonstrated a selective impairment in naming and pointing to facial expressions. His intact language functions and his ability to perfo... well on a variety of perceptual and associative emotional facial tasks suggest that this deficit is best defined as an anomia for facial expression induced by a visual-verbal disconnection. Bowers and Heilman (in Rapscak et al, 1989) contended that right hemisphere damage may on occasion produce an anomia for facial expressions by disconnecting right hemisphere regions important for processing facial affect from language areas.

In the present study LDD2 appeared to present with a highly selective naming deficit for a biologically significant category of visual stimuli: facial expressions conveying linguistic information in sign. These results appear to resemble a visual-verbal disconnection syndrome which is category-specific, as described by Rapscak et al, (1989). LDD2, like the above-mentioned cases, performed well on all facial tasks except when it involved naming the facial expression. He differed from the case reported by Rapscak et al (1989) as he presented with receptive and expressive sign language impairments and visuospatial impairments. However it must be noted that his naming abilities as tested on the BDAE subtests (Responsive Naming, Visual Confrontation and Animal Naming) were well preserved. This would suggest that his poor performance on the test which required the naming of facial expressions cannot be accounted for by a general naming deficit. Nor could his comprehension impairment as noted on the BDAE subtests account for this deficit as he performed well on the second test, "Choose the Correct Facial Expression", which required the subject to point to and identify the target facial expression.

Category-specific impairments have been described both in the visual semantic and in the verbal semantic system (see Rapscak et al, 1989). Rapscak et al (1989) noted that category-specific impairments in the visual semantic system present clinically as category-

specific visual agnosias, whereas category-specific impairments in the verbal semantic system present as category-specific naming or comprehension deficits.

Hence from the results obtained on the Grammatical Facial Expression Tests LDD2 appeared to present with a deficit in the naming of facial expressions used for linguistic purposes in sign which may have been induced by a visual-verbal disconnection.

LDD3 displayed much difficulty in both the first and second subtests, obtaining scores of 37,5% and 56,25% respectively. These results would suggest a deficit in the perception and processing of facial expressions used in sign. The low score of 37,5% obtained on the Name the Grammatical Facial Expression Test may reflect the additional linguistic complexity involved in the task of having to name the expression presented.

The difficulties experienced by LDD2 and 3 on these tasks, in conjunction with the results from the Benton Facial Recognition Test and their expressive use of facial expression in spontaneous signing, will be reviewed and discussed further in Chapter Six.

5.2 ANALYSIS OF THE NARRATIVE DISCOURSE PRODUCTIONS

This section comprises the findings from the analysis of the narrative discourse productions of the control and learning disabled subjects. The results are reported in accordance with the purposes of such analysis outlined in Chapter Four. The results of the analysis undertaken on a suprasentential (macrolinguistic) level are discussed. This includes the results from an objective analysis of coherence and cohesion as well as the ratings evaluating the content (coherence) and clarity (cohesion) of the discourses produced. Some additional findings from the narrative discourse productions of the learning disabled subjects such as the use of nonmanual features and vocabulary are also reported.

5.2.1 Objective Analysis

5.2.1.1 Number of events

As the narrative discourse productions were being analysed only on a macrolinguistic and not on a microlinguistic level, the basic unit of an "event" was used for segmenting the data. For the purposes of this analysis, an event was defined as a change in place or character. The number of events included in each subject's narration and across all categories were counted and are presented in Table 5.2 (see below under Coherence). The number of events varied across all subjects.

5.2.1.2 Length of Narrative

The number of signed words within each narration served as a measure of length of narrative. The figures illustrating the length of the narratives are presented in Table 5.2. The learning disabled deaf subjects generally produced more lengthy narrations. False starts were not included in the count, but repetitions and immediate repetitions were included, as they play an important role in emphasis in sign. However in the case of LDD3, the use of repetitions as an intensifier as opposed to a linguistic parameter, reflecting a word retrieval deficit, was not always clearly defined.

It was found that the learning disabled generally produced more lengthy stories than the control subjects. This would support the findings of Ripich and Griffith (1989) and Merrit and Liles (1987) regarding the length of narratives produced by hearing learning disabled children. Further research in this area, particularly involving hearing learning disabled adults and learning disabled deaf adults, across various discourse tasks, is necessary before any definitive conclusions can be made about the quantity of information produced in the narratives of learning disabled deaf or hearing adults.

5.2.1.3 Temporal Organisation of Events

All subjects' narratives generally showed preservation of the chronological sequence of events.

Although sequencing problems were shown for all LDD subjects on the BDAE Automatised Sequence subtest, they showed no deficit in the order in which story events were recalled from the picture book. Graybeal (1981) concluded that story grammar analyses may not pick up the kinds of disorganisation problems such as sequencing difficulties that are thought to be characteristic of language impaired and learning disabled children. Roth and Spekman (1986) suggested that a more plausible conclusion may be that a recall task is not sensitive to sequential problems. On the other hand it is proposed by the writer that whether sequential problems will be revealed depends on the type of recall task and the type of stimuli to be recalled. In this particular study the ability to recall the sequence of events from a visual picture story did not tap problems in sequencing.

5.2.1.4 Coherence

Superstructure

The ability of the learning disabled deaf subjects and the control subjects in preserving narrative structure was determined by classifying events into six categories: abstract, setting, complicating actions, resolution, coda and evaluations. The number of events within each category, for each subject, is represented in Table 5.2. As can be seen from the table, both control and learning disabled subjects had all the essential elements in their narrative discourse productions. None of the subjects, however, used an abstract, and only three subjects, C1 and LDD1 & 2, used a coda. However, as has been noted by Ulatowska et al (1983), both the abstract and coda are optional elements.

Table 5.2: Events classified within the six categories of narrative structure

	C1	C2	C3	LDD1	LDD2	LDD3
Abstract	-	-	-	-	-	-
Orientation	5	4	4	3	6	3
Complicating action	20	34	48	67	30	55
Resolution	1	1	1	1	1	1
Coda	-	-	-	1	1	-
Evaluation	26	33	81	109	39	56
Total no. of events	26	40	53	72	38	59
Total no. of words	134	227	422	574	371	550

Evaluations

As discussed in Chapter Four, reliability for the scoring of evaluation and referencing was assessed by having a second judge, a speech and language pathologist familiar with sign, independently score 20% of each subject's narrative discourse sample. The 20% of each sample was randomly selected by the second scorer. Pearson Product Moment correlation coefficients were computed and statistical significance was determined. The correlation coefficients for the total scores obtained between the two scorers, across all six subjects' samples for evaluation, was 0,9658, which was significant at the 1% level.

The results of the analysis of evaluative elements used by all subjects in their narrative discourse productions are presented in Table 5.3. The number of evaluative elements used in each subtype is displayed, and also expressed as a percentage of the total number of evaluative elements used. In addition the total number of evaluative elements used by each subject is also given as a percentage of his or her total number of words.

This analysis revealed that LDD2 and 3 used a slightly lower percentage of evaluative elements in their narratives than LDD1 and the control subjects. Their lower percentage in the usage of nonmanual signs, multichannel signs and ritual utterances, and higher percentage of gestures, especially exclamations, as compared to the control subjects, suggests an impairment in the expression of evaluative elements in sign in narratives.

The main points from the analysis of the use of evaluative elements across all subjects are:

1. Intensifiers formed the major category for expressing evaluative elements for all subjects. The use of comparators as evaluative elements was substantially less than the use of intensifiers across all subjects. Evaluative elements involving explications were used by all signers; however, across all subjects no more than 11% of the total number of evaluations fell into this category. Correlatives were not used by any of the signers.
2. LDD2 and 3 produced slightly less evaluation overall when compared with the normal controls and LDD1.

Table 5.3: Use of evaluative elements in the narrative discourse productions
(numbers of evaluative elements in each subtype and each category are expressed as percentages of the total number of evaluative elements)

	C1	C2	C3	LDD1	LDD2	LDD3
Intensifiers						
gestures	3 (11,54%)	0 (0%)	7 (8,43%)	16 (14,55%)	13 (31,71%)	12 (21,43)
nonmanual features	3 (11,54%)	10 (22,22%)	12 (14,46%)	8 (7,27%)	0 (0%)	6 (10,71%)
quantifiers	0 (0%)	0 (0%)	2 (2,41%)	0 (0%)	1 (2,44%)	1 (1,79%)
repetition	6 (23,08%)	1 (2,22%)	5 (6,02%)	21 (19,09%)	7 (17,07%)	9 (16,07%)
multichannel signs	8 (30,77%)	18 (40%)	24 (28,92%)	24 (21,82%)	3 (7,32%)	8 (14,29%)
"thumbs up"	4 (15,38%)	5 (11,11%)	13 (15,66%)	16 (14,55%)	0 (0%)	1 (1,79%)
Total intensifiers	92,31%	75.56%	75,9%	77,27%	58,54%	66,07%
Comparators						
negatives	-	4 (8,89%)	7 (8,43%)	-	-	2 (3,57%)
futures	-	-	-	1 (0,91%)	7 (17,07%)	-
modals	-	-	-	-	1 (2,44%)	-
questions	1 (3,85%)	4 (8,89%)	4 (4,82%)	10 (9,09%)	3 (7,32%)	10 (17,86%)
quasimodals	-	-	2 (2,41%)	-	-	-
imperatives	-	-	1 (1,2%)	2 (1,82%)	1 (2,44%)	2 (3,57%)
superlatives	-	-	-	-	-	-
comparatives	-	-	1 (1,2%)	-	1 (2,44%)	-
Total comparators	3,85%	33%	18,07%	11,82%	31,71%	25%
Correlatives						
be + -ing	-	-	-	-	-	-
-ing without be	-	-	-	-	-	-
double appositives	-	-	-	-	-	-
double attributives	-	-	-	-	-	-
Explication	1	3	5	12	4	5
Total explicators	3,85%	6,67%	6,02%	10,91%	9,76%	8,93%
Total number of evaluative elements	26	45	83	110	41	56
Total number of words	134	227	422	574	371	550
Total no. of evaluative elements expressed as a percentage of the total no. of words	19,40%	19,82%	19,67%	19,16%	11,05%	10,18%

3. Within the category of intensifiers, few quantifiers were used. The amount of use of repetition was varied across all subjects.
4. The LDD subjects produced a higher percentage of gestures than the control subjects, with LDD2 and 3 producing a notably higher percentage of gestures than the control subjects and LDD1. These gestures mainly consisted of exclamations.
5. LDD2 used no nonmanual behaviours to express evaluative elements in his narrative production.
6. LDD2 and 3 used a lower percentage of multichannel signs than the control subjects and LDD1. The high percentage of multichannel signs used by the control subjects indicates that multichannel signs may play an important role in the evaluative elements of signed narratives.
7. A ritual utterance "thumbs up", used frequently by the control subjects and LDD 1, was not used at all by LDD2 and only once by LDD3. As mentioned in Chapter Four, "thumbs up" conveys various meanings in English such as "okay", "good", "nice", "fine", "great", etc, apart from functioning as a pause marker.

The finding of a slightly lower percentage of usage of evaluative elements by two of the learning disabled subjects in this study supports the findings noted by Ripich and Griffith (1988) in which the difficulty in including the feelings and goals of the main character and the involvement of thoughts rather than actions persisted with the older subjects with learning disabilities. This suggests that information stressing emotion and character development may need to be emphasised during instruction to assist the student with learning disabilities in attending to and presenting information about characters.

5.2.1.5 Cohesion

Spatial Referencing

As discussed in Chapter Four, interrater reliability concerning the analysis of spatial referencing was established. The total correlation coefficient obtained between the two raters, across all six narrative samples for referencing, was 0,9870, which was significant at the 1% level.

The distribution of references used by each subject, in the four categories: performatives, articulating the sign for the referent, agreement verbs, and indexing, is displayed in Table 5.4. The percentage of references within each category is expressed as a percentage of the total number of references for each subject.

Table 5.4: Number of references used within each category

	C1	C2	C3	LDD1	LDD2	LDD3
PERFORMATIVES	18 (45%)	24 (44,44%)	39 (45,35%)	30 (26,79%)	20 (29,41%)	19 (21,59%)
NOMINALS	12 (30%)	11 (20,37%)	28 (32,56%)	56 (50%)	23 (33,82%)	39 (44,32%)	
PRONOMINALISATION	0 (0%)	0 (0%)	5 (5,81%)	15 (13,39%)	20 (29,41%)	12 (13,64%)
VERB AGREEMENT	10 (25%)	19 (35,19%)	14 (16,28%)	11 (9,82%)	5 (7,35%)	18 (20,45%)
TOTAL	40	54	86	112	68	88

An analysis of the results of the distribution of spatial references in the discourse productions revealed that the learning disabled deaf subjects exhibited a disruption in referencing in the form of an excessive use of nouns or pronouns. In addition, LDD 1 and 2's disruption in referencing was also indicated by their limited use of verb agreements. The following trends were identified:

1. All LDD subjects used fewer performatives as spatial references than the control subjects.
2. A higher percentage of explicit referent nouns was used by LDD1 and 3 than by the control subjects and LDD2.
3. In general the LDD subjects used more pronouns than the control subjects, with LDD2 using a markedly higher percentage of pronouns than all other subjects. C1 and C2 showed no evidence of usage of pronouns.
4. LDD1 and 2 showed a lower percentage of usage of verb agreements than LDD3 and the control subjects.
5. On further examination of the use of referent nouns it was observed that LDD1 was the only subject who established a nominal and then role-played the actions completed by that nominal. Whether this is considered unnatural in sign language needs further investigation.

Poizner et al (1987) noted that normal deaf adults use approximately 2:1 nouns:pronouns in discourse. However in this research, this ratio of 2:1 noun:pronoun usage was not found. The control subjects demonstrated minimal or no usage of pronouns. Among the LDD subjects, LDD1 and 3 produced approximately 3:1 nouns:pronouns and LDD2 used approximately 1:1 nouns:pronouns. The difference in usage of pronouns reported by Poizner et al (1987) and in this research may be accounted for by the particular story used in this research to elicit the narrative discourse production. The "Snowman" story involves for the most part two primary characters. It is proposed that if there had been additional characters there might have been a greater need for the use of pronouns in referencing.

The control subjects' limited use of pronouns was counterbalanced by their extensive use of performatives and verb agreements as cohesive devices. The opposite was found among the LDD subjects, who showed a greater use of pronouns with fewer performatives (LDD1, 2 and 3) and fewer verb agreements (LDD1 and 2) being used as cohesive devices. The limited number of verb agreements used by LDD1 and 2 may reflect a more general deficit in their productive use of space in signed discourse. Although no definitive conclusions can be made about the referential disruption among the LDD subjects in this research it appears that LDD1 and 3's higher percentages of noun usage and LDD2's higher percentage of pronoun usage would indicate some disruption in referencing. In addition, although an error analysis was not completed, an informal qualitative analysis indicated that LDD2 and LDD3 frequently used pronouns without establishing prior referents and in ambiguous contexts. This is illustrated in the following examples taken from LDD2 and 3's narrative productions:

> FINISH WHEN OUT PRO.3 ASK WANT FOR FOOD SUPPER HERE NOW (NOD) PRO.3 SAID FINE NO PROBLEM.

This could either be translated into English as:

> "When they had finished outside, the boy asked the snowman if he wanted supper, here, now. The snowman nodded (yes) and said fine, no problem."

or as:

> "When they had finished outside, the snowman asked if he could have supper here now. The boy nodded (yes) and said fine, no problem."

In this example from LDD2's narrative, it is not clear whether the snowman is asking the boy if he could have supper or it the boy is asking the snowman if he wants supper. Nor is it clear who responded by nodding. This ambiguity arose from the lack of prior referents and the lack of indexing to nominals established in specific loci. In both instances when LDD2 used an index he pointed to a random space in front of his torso. No use was made of role-playing (performatives) during this utterance.

An example of ambiguity in the use of pronouns and nominals is reflected in the following example from LDD3's narrative production:

> MAN LOOK-DOWN MAN EXPLAIN TO SNOWMAN ABOUT POSS.3 POSS.1 FATHER PRO.3 TEETH GONE THEN PUT TEETH-IN PRO.3 MAN

The first "man" referred to the snowman and the second "man" referred to the boy. In this case the second "man" was the incorrect nominal; it should have been "boy". Moreover the subject used the pronouns "his" and "my" which may reflect confusion as to when he was using performatives.

Although no literature concerning a disruption in referencing in sign language by learning disabled deaf could be located, use of reference is reportedly disrupted in several neurological hearing groups, such as Alzheimers Dementia and schizophrenia, as well as in aphasia. Disruption of reference in aphasia has been fairly well documented (Berko-Gleason et al, 1980; Cicone, Wapner, Foldi, Zurif and Gardner, 1979; Mathews, 1981; Ulatowska, North and Macaluso-Haynes, 1981; Ulatowska et al, 1983, in Chapman and Ulatowska, 1989). The patterns of referential disruption have been described as an abnormal distribution of pronouns and nouns. Specifically this has been described in aphasia as an excessive use of nouns or an excessive use of pronouns, use of pronouns without a prior noun referent and infrequent reidentification by a noun form (Chapman and Ulatowska, 1989). Similar findings have been reported among hearing language disordered children. It is clear that future research in the area of

referencing in normal and learning disabled deaf adults and children is needed. In addition greater use of reliability measures, such as intra-coder agreement, internal consistency of responses, and stability of scores across testing sessions (see Strong and Shaver, 1991), is required before any reliability and generalisability of results can be confirmed.

Conjunctions

In all the subjects' narrative discourse productions, few conjunctions were used. The narratives produced by the subjects varied in length so the number of conjunctions used in each narrative is expressed as a percentage of total narrative length. The percentage of conjunctions used by all subjects is presented in Table 5.5. The most frequently used conjunction was "then". LDD3 tended to use the "then" relation more frequently than other subjects; however it appeared to function as a sentence starter device rather than a conjunction per se.

Table 5.5: Conjunctions used in the narrative discourse productions

	C1	C2	C3	LDD1	LDD2	LDD3
Total no. of conjunctions	5	1	7	1	1	24
No. of conjunctions expressed as a percentage of the total no. of words	3,73%	0,44%	1,66%	0,17%	0,27%	(4,36%)

Differences in the use of conjunctions between hearing language disordered children and normal-language children have been reported (Ripich and Griffith, 1988; Roth and Spekman, 1986). Roth and Spekman (1986) note that the "then" relation can be considered the simplest or most basic connection and typical of many stories that merely present events in their proper temporal sequence.

5.2.2 Content and Clarity Ratings

As discussed in Chapter Four, the content and clarity ratings were developed so as to compare the results of the objective analyses of the discourse productions to the subjective evaluations of listeners.

In order to determine interrater reliability for the content and clarity ratings, Pearson Product Moment correlation coefficients were computed and tested for statistical significance. The correlation coefficients computed for the content and clarity ratings are displayed in Tables 5.6 and 5.7 respectively.

Table 5.6: Interrater reliability for content ratings - Pearson Product Moment correlations

	Q1	Q2	Q3	Q4	Q5	TOTAL
R1+R2	0,6547*	0,9333**	1,000**	0,5774	0,6405	0,9596**
R1+R3	1,000**	0,9333**	1,000**	0,7474*	0,7559*	0,9673**
R2+R3	0,6547*	1,000**	1,000**	0,2582	0,7868*	0,9479**

* = significant at the 5% level ** = significant at the 1% level

The total correlation coefficients between raters for the content ratings were significant at the 1% level. However as can be seen from Table 5.6 the correlation coefficients between raters 1 & 2 and raters 2 & 3 on question 4, and between raters 1 & 2 on question 5 were low and were not found to be significant. This may suggest that these particular questions need to be refined or it may imply that in future more discussion prior to rating is needed in order to establish a standard according to which the subjects' narratives are to be rated.

Table 5.7: Interrater reliability for clarity ratings - Pearson Product Moment correlations

	Q1	Q2	Q3	TOTAL
R1+R2	1,000**	1,000**	0,08980**	0,9757**
R1+R3	1,000**	0,9206**	0,8121*	0,9392**
R2+R3	1,000**	0,9206**	0,7293*	0,9479**

* = significant at the 5% level ** = significant at the 1% level

The total correlation coefficients between raters for the clarity ratings were significant at the 1% level (see Table 5.7). All correlation coefficients computed between raters for questions 1, 2 and 3 were significant at the 1% level, except that between rater 2 and 3 on question 3, which was significant at the 5% level.

The total rating scores provided by each rater, for all subjects, for the content and clarity rating scales are presented in Tables 5.8 and 5.9.

Table 5.8: Total scores provided by each rater for content rating (coherence) (max. poss. score 15)

	C1	C2	C3	LDD1	LDD2	LDD3
Rater 1	14	14	13	14	11	15
Rater 2	14	13	14	14	9	15
Rater 3	13	14	14	14	11	14

Table 5.9: Total scores provided by each rater for clarity rating (cohesion) (max. poss. score 9)

	C1	C2	C3	LDD1	LDD2	LDD3
Rater 1	9	9	9	7	6	6
Rater 2	9	9	9	8	6	7
Rater 3	9	9	9	7	6	6

As can be seen from Table 5.8, all subjects except for LDD2 received high ratings for content. A possible explanation for LDD's lower rating will be discussed below. All the LDD subjects were rated lower than the control subjects for clarity, with LDD2 and 3 receiving the lowest ratings. The comprehensibility of the language in both LDD2 and 3's narrations was evaluated as "not completely clear". The numerous communication breakdowns, paraphasic errors and scarce use of multichannel signs found in LDD2 and 3's productions may have accounted for this evaluation. All three LDD subjects received low ratings for clarity as to whom they were referring throughout their productions. These ratings would converge with the findings from the objective analysis in which a

referential disruption was suggested for the LDD subjects. LDD1 and 3's demarcation of the physical locations from the story within their signing space was evaluated as "not completely clear" which would converge with the findings from the objective analysis of limited use of verb agreements in spatial referencing. On the other hand LDD3 was evaluated as "completely clear" on this aspect, which would support the findings of his adequate use of verb agreements in spatial referencing. Although LDD1 and 3 presented with numerous linguistic deficits in their narrative discourse productions, as was determined in the objective analysis and in the low ratings received for clarity, they both obtained high content ratings. These findings would support the claim made by Keenan, Baillet and Brown (1984, in Glosser and Deser, 1990). They claimed that coherence in discourse does not depend exclusively on the linguistic cohesion of a text, but rather depends on conceptual links within a discourse production which may or may not be linguistically explicit. However the low ratings for content received by LDD2, which were not supported by the findings from the objective analysis of the coherence of his narrative production, may be explained by the poor linguistic cohesion in his narrative. The particular cohesive deficits shown by LDD2 in the objective analysis and in his lower clarity rating may have resulted in a less well-formed and coherent production.

5.2.3 Additional Aspects: Nonmanual Features and Vocabulary

5.2.3.1 Nonmanual features

As discussed in Chapter Four, although nonmanual behaviours extend over many different sentence types (Liddell, 1980; Baker and Cokely, 1986), in this research analysis of the use of nonmanual behaviours was restricted to their role in questions, negation, adverbials, intensifiers and multichannel signs. The presence of nonmanual behaviours for these grammatical and lexical functions in each subject's narrative was investigated.

This analysis yielded the following findings:

1. The control subjects and LDD1 displayed effective use of nonmanual behaviours for the above-mentioned grammatical and lexical functions in their discourse productions.

2. LDD 2, however, showed an inconsistent use of nonmanual behaviours as grammatical markers. Use of nonmanual behaviours for marking negation, intensifiers, adjectival phrases, adverbials and questions was found. However on frequent occasions no nonmanual behaviours were used for marking questions, adverbials and intensifiers. In addition limited use of multichannel signs throughout his discourse production was noted. This may be due either to the formational complexity or to the linguistic complexity of these signs. In addition all multichannel signs have an obligatory nonmanual feature and given that LDD2 presented with difficulties in the production of nonmanual behaviours it is probable that multichannel signs would not be used.
3. LDD3 displayed similar behaviour with regard to the expressive use of nonmanual behaviours to LDD2. The presence of nonmanual behaviours was found to be inconsistent when marking questions and adv ls. LDD3 also used a limited number of multichannel signs in his discourse production. In addition some of the multichannel signs that were used did not appear to have the necessary nonmanual behaviour accompanying them. LDD3's poor use of nonmanual behaviour also converges with the low scores he obtained in the perception and comprehension of nonmanual behaviour in the Grammatical Facial Expression tests.

In addition to the above objective analysis, a rating system was devised to evaluate the expressive use of nonmanual behaviour in the discourse productions of all subjects. Use of nonmanual behaviours was rated on a three-point scale: 1 - poor use of nonmanual behaviours; 2 - average use of nonmanual behaviours; 3 - good use of nonmanual behaviours. The results of the ratings are presented in Table 5.10. In this subjective rating LDD 2 and 3 were the only subjects to obtain the low score of 1, which supports the findings of the objective analysis above.

Table 5.10: Ratings obtained for nonmanual behaviours

	C1	C2	C3	LDD1	LDD2	LDD3
Rater 1	3	3	3	3	1	1
Rater 2	3	3	3	3	1	1
Rater 3	3	3	3	3	1	1

5.2.3.2 Vocabulary

LDD1 presented with a noticeably larger percentage of gesture and mime in his discourse production than any of the other subjects. The amount of gesture or mime used by each subject in their discourse productions is displayed in Table 5.11. LDD1's high percentage of gesture and mime is thought to reflect a possible vocabulary deficit. In addition he presented with many semantically empty filler items, in which he would move his arms around at random, as if signing "um", "er". He also exhibited an example of a substitution of a phonological relationship in English, in the use of the incorrect sign for the word, i.e. "cocktail " for "carrot". It is proposed that his high percentage of gesture and mime and frequent use of semantic empty fillers, in conjunction with the findings of a suggested word retrieval deficit on the BDAE, suggests a vocabulary deficit.

Table 5.11: Gestures used in the narrative discourse productions

	C1	C2	C3	LDD1	LDD2	LDD3
No. of gestures expressed as a percentage of the total no. of signs	7%	6%	4%	21%	5%	7%

LDD2 presented with a number of linguistic parameters which would suggest a vocabulary deficit in sign. He exhibited examples of circumlocution, e.g. "one large box of cold" instead of the word "freezer". Numerous semantic empty fillers were found throughout his discourse production. These were in the form of deixis, with no grammatical function but rather used as empty fillers such as "um", "er". He also produced word substitutions from within the same taxonomic group, such as "introduce" for "lead". In addition there were many communication breakdowns throughout his discourse production, such as stalls in the forms of repetitions of parts of words, whole words and parts of phrases, and abandoned utterances.

Similarly, LDD3 presented with a considerable number of linguistic parameters which would be indicative of a vocabulary deficit. In particular he produced numerous sentence starter devices such as "then". His discourse production was characterised by a large

number of perseverative repetitions not used for emphasis, as illustrated in the following examples from his narrative.

> WAKE-UP LOOK CHECK-UP 'AH' RATHER GO BACK ME THINK 'AH' BACK 'THINK THINK' GO BACK

and

> SAW OPEN SEE SEE SEE WHAT IS TEETH FALSE TEETH IN GLASS IN FALSE IN WHAT IT?

Semantic empty filler items in the form of deixis, semantic substitutions, e.g. "paddle" for "run", "open" for "on", circumlocutions, and communication breakdowns such as stalls and repetitions of phrases were noted in his production.

The incidence of hearing children with learning disabilities exhibiting vocabulary deficits throughout their school years has been estimated to be as high as 80% (Wiig, 1981, in Wallach and Butler, 1984). Johnson and Mykelbust (Wallach and Butler, 1984) claim that learning disabled individuals know fewer words, retain restricted word meanings and are concrete and literal in symbolisation and conceptualisation skills. In addition MacLachlan and Chapman (1988) note that quantitatively the language learning disabled children's rate of communication breakdown in narration (including repetitions, filled pauses, self-initiated repairs and abandoned utterances) can be accounted for, at least in part, by increases in communication unit length and hence in an increased opportunity for dysfluency. Although an analysis of communication unit length was not undertaken in this research the lengthy narrations produced by the LDD subjects may have increased the opportunity for the communication breakdowns observed in their productions.

The findings from this study support those of Wallach and Butler (1984), who found that word retrieval and word knowledge deficits persist into adolescence and do not disappear or self-remediate with increasing age.

From the presentation and discussion of the performance of both control and learning disabled deaf subjects on the BDAE, formal sign language tests and the narrative discourse task, it is evident that the LDD subjects presented with both a receptive and an expressive deficit in sign language. A detailed summary of each learning disabled deaf subject's linguistic profile will be undertaken below in section 5.4. We turn first, however, to the results of the cognitive test battery.

5.3 COGNITIVE PERFORMANCE

The results obtained by all subjects on the cognitive tests are now presented. Interpretation of the subjects' performance on this battery was carried out in consultation with a neuropsychologist. Suggested areas of deficit are highlighted in Table 5.12 (in the form of raw scores and where applicable scaled scores (SAWAIS)) and these will be the focus of the following discussion.

In this study much caution had to be exercised when interpreting test results as a result of the lack of normative performances and the use of outdated norms.

No normative data exists in South Africa or elsewhere for the deaf population for the cognitive tests used in this study. As mentioned previously in Chapter 3, normative performances for deaf students have unfortunately not been established for many commonly used cognitive instruments. Moreover, not only is there an absence of norms for cognitive tests for the South African deaf population, but there is also a serious lack of norms for the specific cognitive tests used in this study and for cognitive tests in general, for the South African hearing population.

In addition as four subtests of the SAWAIS formed part of the cognitive assessment, it must be noted that the norms established for hearing South African persons on the South African Wechsler Adult Intelligence Scale (SAWAIS) are now forty years old (Nell, 1994). Nell (1994) argues that old norms do not reflect the ongoing educational and experiential development of the age cohorts in this particular population. The older the norms, the more they inflate individual ability levels so that even significantly impaired persons may appear to be average. Furthermore he proposes that the continued use of the SAWAIS with its outdated norms and unknown statistical properties may result in misleading diagnostic conclusions.

The development of culturally appropriate and sensitively normed cognitive tests for both deaf and hearing South African population groups is clearly needed. Hence in this study the norms provided for the cognitive tests were merely used as guidelines when determining profiles of cognitive performance for the LDD subjects relative to one another, matched controls and hearing subjects.

Table 5.12: Results obtained on the cognitive tests

	C1	C2	C3	LDD1	LDD2	LDD3
SAWAIS Digit Span	DF 7 DB 5 SS 11,5	DF 8 DB 5 SS 12,5	DF 5 DB 4 SS 8,5	DF 4 DB 5 SS 8,5	DF 5 DB 4 SS 8,5	DF 3 DB 4 SS 6,0
Grooved Pegboard	88	62	80	78	85	76
SAWAIS Digit Symbol	46 SS 11,5	59 SS 14	44 SS 11	48 SS 12	49 SS 12	50 SS 12
Draw - copy geometric	0	0	0	0	2	0
Rey Complex Figure - copy	34 (80%)	36 (100%)	35 (90%)	35 (90%)	34 (80%)	36 (100%)
Free Drawing (bicycle/ house)	normal	normal	normal	normal	normal	normal
SAWAIS Block Design	32 SS 12,5	28 SS 11	27 SS 10,5	32 SS 12,5	18 SS 8,5	28 SS 11
Benton Facial Recognition	54	47	54	50	50	37
SAWAIS Arithmetic Test	6 SS 9	3 SS 6,5	3 SS 7,5	4 SS 7,5	4 SS 7,5	3 SS 7,5
Digit Symbol - incidental recall	8/9	7/9	7/9	4/9	1/9	2/9
Rey Complex Figure - delayed recall	31 (100%)	30 (100%)	28 (90%)	25 (70%)	7 (10%)	23 (50-60%)
Paragraph Memory Test - immediate	18/20	16/20	16/20	12/20	11/20	13/20
Paragraph Memory Test - delayed	18/20	16/20	15/20	9/20	8/20	10/20
Signed RAVLT - Trial I	7	7	8	10	4	5
Signed RAVLT - Trial V	15	15	15	15	15	15
Signed RAVLT - delayed	15	15	13	11	7	11

● defective or borderline functioning

5.3.1. Arousal

Orientation

All subjects were orientated for person, place and time.

Attention

Attention was measured by the Digit Span Forwards Test. Digits Forwards is more closely related to the efficiency of attention than of memory (Spitz, 1972, in Lezak, 1983). As suggested by Lezak (1983), it is more useful to examine the raw scores, as they reflect the possible differences in digits forwards and backwards, whereas the combined score is misleading. According to Spitz (1982, in Lezak, 1983), spans of 6 or more are well within normal limits, spans of 5 may be marginal to normal, a span of 4 is definitely borderline, and 3 is defective. Except for LDD1 and 3, all subjects' scores reflected normal spans of attention. LDD1's attention span was borderline, although the number of digits he recalled in the Digits Backwards Test (see section 5.3.5) may suggest that this borderline score of 4 reflects factors other than attention, such as test anxiety. LDD3's attention span was considered to be defective as he was only able to recall 3 digits. The raw score differences between digits forwards and backwards fell within the normal spread of reported differences. As mentioned in Chapter Three, Bellugi and Klima (1979) reported that the memory span for signs may be somewhat shorter than the memory span for spoken words. They based the difference between memory span for signs and spoken words on the basis of the amount of time required to execute a signed or spoken word. Despite this difference, two of the controls still recalled more than 6 digits, which is considered normal for the spoken word.

5.3.2 Visuomotor Functions

The Grooved Pegboard Test and the SAWAIS Digit Symbol Test were used to examine the visuomotor functions of all subjects.

Grooved Pegboard Test

All subjects scored within normal limits for both dominant and nondominant hands on this test. The scoring and normative data provided by Trites (1989) were utilised.

SAWAIS Digit Symbol Test

All subjects performed within the average-superior range on the Digit Symbol Substitution Test, indicating normal visuomotor functions. In addition, there was no evidence of rotations, simplifications or other distortions of the symbols suggestive of a visual perceptual impairment.

The results from both these tests suggest normal visuomotor functioning for all subjects.

5.3.3 Visuoconstructional and Visuospatial Functions

Geometric Design Reproduction Test (Nell, 1985)

All subjects correctly reproduced the target shapes, which consisted of a circle, triangle, cross, diamond and arrow. Perfect reproduction is scored as 0; accurate shapes slightly too big or small are given a 1; mildly distorted shapes a 2; moderately distorted shapes a 3; severely distorted shapes a 4; and unrecognisable scrawls, 5. The total score is the sum of all 5 designs scores; best is 0 and worst is 25 (Nell and Jansen, 1987).

Rey Complex Figure Test

Copying of the Rey Complex Figure was administered to investigate perceptual organisational abilities. All subjects executed well-planned drawings and displayed no impairments in perceptual organisation. All subjects scored between the 80th and the 100th percentile.

Free Drawing Tasks

The free drawing tasks involved drawing a house and a bicycle. Qualitative analyses of free drawings, rather than the use of a formal scoring system, is commonly undertaken in neuro and assessments (Lezak, 1983). Hence in this study a qualitative analysis of the free drawings was undertaken, and all subjects appeared to draw well-proportioned houses and bicycles including all necessary details.

SAWAIS Block Design Test

All subjects performed well on the SAWAIS Block Design Test except for LDD2. Although his score of 8,5 is regarded as normal for his reported average IQ, he showed much difficulty on this task, adopting a random trial and error approach. The designs

which entailed constructions involving orientation of the diagonal presented him with the most difficulty. Occasionally he would lose sight of the squared format of the design and break the configuration, placing blocks linearly horizontally. He had a tendency not to deal with the whole but rather to work in what Patterson and Zangwill (1944, in Kaplan, 1988) call a piecemeal approach, block by block. The results of LDD2's performance on this test suggest that he may present with a deficit in visuospatial and or visuoperceptual abilities. This result would support the findings of visuoperceptual deficits noted in his educational school reports.

In summary, then, all subjects except LDD2 presented with normal visuoconstructional abilities, whilst LDD2's performance on the SAWAIS Block Design Recognition Test may suggest a visuoconstructional and visuospatial impairment.

Facial Recognition

The Benton Facial Recognition Test, which examines the ability to recognise the identity of unfamiliar faces without involving a memory component, was administered to all subjects. All subjects except LDD3 performed well on this test. LDD3 obtained a low score of 37 which indicates severe impairment with regard to the recognition of the identity of faces. It has been suggested that this task has a substantial visuospatial processing component (Dricker et al, 1978, and Warrington and James, 1967, both in Lezak, 1983). However Hamsher et al (1979, in Benton, 1983) note that aphasic patients with defective language comprehension fail on this test at similar rates to those with right hemisphere lesions, and propose that this is because the task has a linguistic component. Whether LDD3's poor performance on this test reflects a visuospatial deficit, or a deficit in the recognition of the identity of unknown faces, or is related to his comprehension deficit, would need further investigation.

5.3.4 Calculation

SAWAIS Arithmetic Test

The SAWAIS Arithmetic Test was used to assess the subjects' calculation skills. The test, which is usually presented in the oral mode, was presented in sign. All subjects, both control and learning disabled, performed poorly on this test, which is thought to be due to numerous factors. It is believed that the test itself may be inappropriate for assessing the calculation skills of the deaf, as it is administered in sign only (not written) and allows for the assessment of mental calculation only and not of written calculation. In the current educational setting, exposure to mental calculation through the medium of sign is rare, and hence it is suggested that skills in mental calculation, especially where story sums are involved, may not be as well developed in the deaf population. In addition this test does not assess aspects such as symbol recognition or spatial dyscalculia. Moreover, it has been regularly documented that arithmetic is a problem for many deaf individuals especially in the school setting, which may be related to the linguistic components of arithmetic. Coupled with the claim that performance in arithmetic may suffer from poor early school attitudes or experiences (Lezak, 1983), this could explain the poor results of deaf persons in general on tests assessing calculation skills. It is recommended that in future investigations of the calculation skills of the deaf more than one test be administered, including tests in the written format. Furthermore, in the future, considering the outdated norms for the SAWAIS (see Nell 1994), tests which are more culturally appropriate and sensitively normed should be employed.

5.3.5 Memory

SAWAIS Digit Span Test - Digits Backwards

All subjects obtained raw scores of 4 to 5 for Digits Backwards. According to Botwinick and Storandt (1974) and Weinberg et al (1972) (both in Lezak, 1983) raw scores of 4 to 5 for Digits Backwards should be considered as being within normal limits. Digits Backwards may be more closely related to working memory rather than the more passive span measured by Digits Forwards (Hayslip and Kennely, 1980; Vernon, 1979, in Lezak, 1983; Shuttleworth-Jordan and Bode, 1993).

Digit Symbol Incidental Recall Test

The SAWAIS Digit Symbol test was followed immediately by the Incidental Recall test. After the standard administration of the Digit Symbol Test, subjects who had not completed the digit symbol substitutions to the end of the test were requested to do so. The subjects were then required to fill in, from memory, as many of the symbols corresponding to each written number as they could recall. The control subjects' recall varied between 7 and 8 out of the 9 symbols, whereas the learning disabled were only able to recall 4 or fewer symbols (see Table 5.12). Normative data for this test are limited (Shuttleworth-Jordan and Bode, 1993). Lezak (1983) reported, without any reference to age group, that 7 out of 9 symbols is at the low end of average for nondisabled persons. Shuttleworth-Jordan and Bode (1993) have presented age-differentiated normative data using the SAWAIS format. These data are based on a South African population of Anglo-Saxon origin, aged 20-89 years, with a mean education of 14,93 years and range of 10-22 years. A mean score of 7 was achieved by the 20 to 39 year old age group, which is similar to the score reported by Lezak (1983). The results from this test would indicate that all three LDD subjects presented with an impaired short-term visual memory.

Recall of the Rey Complex Figure Test

A 30-minute delayed recall trial of the Rey Complex Figure Test was administered to all subjects. All control subjects scored between the 90th and 100th percentile on recall of the figure. LDD1 scored at the 70th percentile, LDD3 at the 50th-60th percentile and LDD2 at as low as the 10th percentile. There are no normative values for delayed recall, but studies using the Taylor figure (1969) suggest that there is little loss after a one hour delay in normal subjects (Mesulam, 1985, cited by Rosselli and Ardila, 1989). Rosselli and Ardila (1989) note that nondisabled subjects can retain about 60% of the figure. Hence LDD1's low score at the 10th percentile would indicate a severe impairment in visual memory. Moreover his production revealed spatial confusion in memory.

Paragraph Memory Test (Nell, 1985)

On the immediate Paragraph Memory Test (Nell, 1985), the control subjects recalled between 16-18 facts. The three learning disabled subjects recalled between 11 and 13 facts. On the delayed paragraph memory test, there was very little or no loss of facts for

the control subjects. However, there was more noticeable shrinkage for the learning disabled subjects, who failed to recall a further three facts. At present there are no normative data available for this test. However on other paragraph memory tests, such as the Wechsler Memory Scale paragraph test, the loss of three facts would be considered borderline. (As mentioned in Chapter Four, the Paragraph Memory Test is similar to Story B of the Wechsler Memory Scale.) Hence the LDD subjects' performance in short-term verbal memory as measured on this particular task, using the guideline from the Wechsler Memory Scale, would then be considered borderline.

Signed Version of the Rey Auditory Verbal Learning Test

On the signed version of the Rey Auditory Verbal Learning Test, the control subjects and the LDD subjects recalled all 15 words within the five trials and showed normal learning curves. The control subjects recalled no less than 13 words on the delayed trial, which reflects normal retention and retrieval. However the LDD subjects all showed a decrease of more than three words from the fifth trial to the delayed recall trial. According to Lezak (1983), Savage and Gouvier (1992) and Mungas (1983), and compared with the results of the control subjects, this would indicate a retention or retrieval problem.

Remote Memory

Both the control and the LDD subjects appeared to present with an intact remote memory from their responses to the Biographical Questionnaire.

In summary of the results of all subjects across the memory tasks, the control subjects appear to present with no deficits in memory, whilst the LDD subjects tended to demonstrate difficulties in recent verbal and visual memory. All LDD subjects appeared to present with intact immediate memory in their performance on the Digit Span Backwards and the signed version of the RAVLT. LDD1 and 3, however, displayed difficulties in immediate memory when it involved phrases and sentences, as indicated by their performance on the Repeating Phrases and Sentences subtest of the BDAE. Possible deficits in recent verbal memory for all LDD subjects was indicated by their performance on the Paragraph Memory Test and on the signed version of the RAVLT. A deficit in short-term visual memory for all three LDD subjects was indicated by their poor performances on the Digit Symbol Incidental Recall st. This finding is supported in

the case of LDD2 by his impaired performance on the Memory Trial of the Rey Complex Figure.

This section has described the subjects' performances on the cognitive test battery. In the following section a detailed summary of the linguistic and cognitive profiles of each learning disabled deaf subject will be presented. In addition an attempt will be made to describe the relationship between each subject's linguistic and cognitive functions.

5.4 SUMMARY OF THE LINGUISTIC AND COGNITIVE FUNCTIONS OF EACH LEARNING DISABLED DEAF SUBJECT

5.4.1 LDD1

On the battery of tests used in this research LDD1 presented with a receptive and expressive sign language impairment and a suggsted memory deficit.

5.4.1.1 Receptive sign language ability

From his performance on the Commands, Complex Ideational Material and Responsive Naming subtests of the BDAE and the formal sign language tests, LDD1 appears to present with a comprehension deficit in sign. This deficit intensifies when the signed material is increased in length and complexity. His comprehension problem is manifested in difficulties in comprehending signs of the nonspatial derivational type as well as spatialised grammatical relations when there is a shift in reference. His difficulty in comprehending signs of the non-spatial type converges with the lower score obtained on the expression of noun/verb distinctions. However his comprehension deficit does not appear to manifest at the phonological level nor does it appear to include the perception and comprehension of linguistic information conveyed by facial expressions. In addition his poor performance on the Responsive Naming Test would suggest difficulties relating to verbal associative skills in sign.

5.4.1.2 Expressive sign language ability

From his results on the Repetition and Naming tasks of the BDAE, and the findings from his narrative discourse production, the following conclusions can be made regarding LDD1's expressive sign language output. He is a fluent signer who exhibits a range of grammatical markers and effective use of nonmanual behaviour to convey linguistic information. He presents with no difficulties in naming. His difficulties in repetition of words and phrases is thought to be partly accounted for by his fluctuating attention and suggested problems in memory. He appears to have a word retrieval deficit, indicated by his performance on the Automatised Sequence and the Rey Auditory Verbal Learning Test. This evidence of a word retrieval deficit would support the findings of a vocabulary deficit noted in his narrative discourse production. The findings from the analysis of LDD1's narrative discourse production revealed an intact ability in establishing and maintaining coherence in his narrative; however, he displayed impairments in the linguistic cohesion of his text. This manifested in disrupted referencing and the poor use of space in determining grammatical relations in sign. His spatial syntactical breakdowns in signing were indicated by the limited use of verb agreements and the high percentage of nouns in his discourse, as well as by the low ratings he received for the use of space in specifying established loci with associated nominals. His spatial syntactical breakdown in signing converges with his poor performance on the test of Verb Agreement with a Shifting Frame of Reference, which implies a breakdown in production and comprehension of spatial syntactical relations in sign.

5.4.1.3 Cognitive abilities

The lack of correlation between LDD1's performance on the Digits Span Forwards Test and the first trial of the signed version of the RAVLT in which he was able to recall 10 words suggests a fluctuating attention span. The results from the Verbal Memory Tests indicate that LDD1 may have difficulty in the retention and retrieval of verbal information. This deficit may account for his poor performance on tests such as the Automatised Sequence Test, Responsive Naming Test and Repetition Tests of the BDAE. It may also contribute to the apparent vocabulary deficit noted in his narrative discourse production. In addition to his proposed deficit in recent verbal memory, his poor

performance on the Digit Symbol Incidental Recall test and his lower score on the recall of the Rey Complex figure compared to that of the controls would suggest a deficit in nonverbal recent memory as well. Although LDD1 appeared to present with a problem in both verbal and nonverbal recent memory, his memory problem did not seem to affect his ability in recalling the positions of nominals established in spatial loci in the Nominal Establishment Test.

LDD1 presented with no difficulties involving visuospatial skills, according to his results on the visuoconstructional tests and the Benton Facial Recognition Test. However he showed evidence of difficulties in the comprehension and use of productive space in signing. This possible dissociation of language and nonlanguage visuospatial functions would suggest support for the findings of Poizner et al (1987), who found a similar dissociation of functions in signers examined in their research (see Chapter Six). However until further testing is completed no firm conclusions regarding a dissociation of these functions can be made. See 6.1.

5.4.2 LDD2

LDD2 also presented with a receptive and expressive sign language impairment. In addition he appeared to present with a memory deficit, a possible impairment in visuoconstructional and visuospatial abilities and a suggested category-specific naming impairment.

5.4.2.1 Receptive sign language ability

The results from the comprehension subtests of the BDAE and the structural tests indicate that LDD2 presents with a deficit in the comprehension of sign. His comprehension deficit was only apparent when the stimuli involved sentences and stories and was not evidenced on a single word level. His comprehension impairment appears to be more severely affected by increased length and complexity of material. Unlike LDD1, LDD2 did not present with a comprehension deficit involving signs of the nonspatial type; however he appeared to experience greater difficulty in the comprehension of spatial

syntactical relations. From his results on the Choose the Correct Facial Expression Test he presented with adequate perception of facial expressions used in sign.

5.4.2.2 Expressive sign language ability

LDD2 presented as a fluent signer exhibiting a range of grammatical markers. He showed no difficulties on the naming and repetition tasks of the BDAE. However his poor performance on the Name the Grammatical Facial Expression Test may suggest a category-specific naming impairment, that of the facial expressions used for linguistic purposes in sign. The results of the analysis of his discourse production showed his expressive signing to be characterised by poor use of nonmanual behaviours, a vocabulary deficit, a disruption of referencing, and an impoverished use of space in determining spatial syntactical relations. LDD2's spatial syntactic breakdowns were reflected in his limited use of verb agreement, the high percentage of pronouns, which were not always indexed correctly to previously established nominals, and the low ratings he received for specifying the space used for marking syntactical relations. As in the case of LDD1, his impairment in the production of spatial syntactic relations converges with his poor performance on both Verb Agreement Tests (with fixed and shifting reference), which implies a production and comprehension deficit involving spatial syntactical relations. LDD2's narrative was fairly well formed and coherent, containing most of the essential elements. However he presented with limited use of evaluations and he received a low rating for coherence. It is believed that the low rating he received for content may be accounted for by the limited number of evaluative comments used, and the lack of clarity in his narrative, resulting from the poor use of facial expressions, poor use of space, and the impairments exhibited in the linguistic cohesive devices employed in his narrative.

5.4.2.3 Cognitive abilities

LDD2 appeared to present with an impairment in both verbal and nonverbal recent memory. His impairment in nonverbal recent memory was suggested from his poor performance on the Digit Symbol Incidental Recall test and his poor performance, below the 10th percentile, on the recall of the Rey Complex figure. His more marked nonverbal recent memory deficit evidenced in the recall of the Rey Complex Figure, as compared

to LDD1 and 3, may account for his slightly lower scores (compared with all other subjects) on the Nominal Establishment Test, which entails recalling nominals established at different loci in space. His suggested impaired verbal memory may contribute to his difficulty in comprehending verbal material of greater length and complexity, as noted on the BDAE subtests.

Unlike LDD1 and 3, LDD2's performance on the SAWAIS Block Design Test and in the Recall of the Rey Complex Figure Test suggested difficulties in the nature of nonverbal spatial functions. In addition, as reported in section 5.4.2.2, he presented with a verbal spatial deficit. This will be discussed in further detail in the first part of Chapter Six.

5.4.3 LDD3

LDD3 presented with a receptive and expressive sign language impairment. However he appeared to present with a more marked receptive deficit than either LDD1 or LDD2. He displayed a possible memory deficit and a deficit in the recognition of the identity of unknown faces and in the perception and production of facial expressions used for linguistic purposes in sign.

5.4.3.1 Receptive sign language ability

According to the results from the comprehension subtests of the BDAE, LDD3 appeared to present with a more marked comprehension deficit in sign than LDD1 and 2. He tended to show more difficulty across the four sign comprehension subtests of the BDAE than the other two LDD subjects, that is, on a single word as well as on a sentence and short story level. However his comprehension deficit involving signs of the nonspatial type, exhibited in the test of morphological processing tests, did not appear as severe as that of LDD1. In addition his comprehension of spatially realised grammatical relations was not impaired on the Verb Agreement Test with a Fixed Framework, but only when there was a shift in reference. His low score in the Responsive Naming subtest of the BDAE may also reflect his comprehension deficit and imply a problem in verbal associative skills.

LDD3 showed marked difficulties in the area of comprehension of facial expressions which carry linguistic information in sign. This was indicated by his poor performance on two of the Grammatical Facial Expression Tests.

5.4.3.2 Expressive sign language ability

LDD3 presented as a fluent signer with good sign agility and a variety of grammatical markers. He exhibited no difficulties in naming, as was determined by the Visual Confrontation and Animal Naming subtests of the BDAE. As mentioned above, his poor performance in the Responsive Naming subtest appeared to be related to his comprehension difficulties. Like LDD1, LDD3 performed poorly on the repetition of high and low probability phrases and his errors occurred in the form of omissions. It is proposed that his difficulty in performing this task may be related to his suggested limited attention span and his poor comprehension and poor memory. The results from the objective analysis and ratings of his narrative discourse production suggest the following characteristics of his expressive signing. His signed narrative was marked by numerous communication breakdowns and was filled with linguistic parameters which would suggest a vocabulary deficit. He used little evaluation throughout his discourse and showed poor use of referencing. He displayed a poor use of facial expressions throughout his discourse sample and utilised few multichannel signs in which the nonmanual feature is an obligatory marker. His impairment in the use of facial expressions converges with his poor performance on the Grammatical Facial Expression Tests and suggests both a production and comprehension deficit regarding facial processing. Unlike LDD1 and 2 he displayed an effective use of productive space in his narrative. This was evidenced by his frequent use of verb agreements, and the higher clarity rating he obtained reflecting his effective use of space with associated nominals. Although LDD3 did not appear to present with a deficit where spatial manipulation is the basis for syntactic organisation, he appeared to present with a deficit in the order of information required for syntactic purposes. However this would require further investigation before any conclusive findings regarding his order information could be made.

5.4.3.3 Cognitive abilities

LDD3 presented with a deficit in attention, as was indicated on the Digits Forwards Test. In addition, he appeared to present with an impairment in verbal recent memory, as was demonstrated on the signed version of the Rey Auditory Verbal Learning Test and on the Paragraph Memory Test. In addition his poor performance on the Automatised Sequences Test of the BDAE and his apparent vocabulary deficit would suggest a word retrieval deficit. A nonverbal recent memory impairment may be indicated by his poor performance on the Digit Symbol Incidental Recall Test and by the lower score he obtained on the recall of the Rey Complex figure compared to the control subjects. However, like LDD1, his high score on the Nominal Establishment Test would suggest that his visual or verbal memory impairment do not interfere with his memory of spatial locations as is used in signing. His poor performance on the Commands, Complex Ideational Material and Repeating Phrases and Sentences subtests of the BDAE may have been affected by his deficit in attention and verbal recent memory.

LDD3 displayed intact visuoconstructional skills on tasks involving drawing and assembling. On the Benton Facial Recognition Test he displayed a severe deficit, showing much difficulty in the recognition of the identity of unknown faces. This result converges with his poor performance on the Grammatical Facial Expression Tests and his poor use of nonmanual behaviours in spontaneous signing.

This section has described the LDD subjects' performance on the linguistic and cognitive test batteries. In the following section a comparison will be made of some of the sign language impairments reported in this study and those reported by Poizner et al (1987).

5.5 COMPARISON WITH PREVIOUS RESEARCH

Poizner et al (1987) examined the sign language behaviour of three deaf signers with left hemisphere lesions and three deaf signers with right hemisphere lesions. In this section an attempt is made to compare the nature of some of the sign language impairments presented by the three left hemisphere lesioned patients and those of the three LDD subjects in this study. Adaptations of the BDAE and the formal sign language tests

developed at the Salk Institute for Biological Studies were used in both studies. However, although the formal sign language tests used in this study were constructed according to the guidelines given by Poizner et al (1987), each test consisted of different test items and therefore strict comparisons between scores cannot be made. Differences between the two studies are an assessment of apraxia and written English carried out by Poizner et al (1987), which was not undertaken in this study, and an assessment of coherence and cohesion in signed narratives and of the perception and use of facial expressions, undertaken in this research and not in the study conducted by Poizner et al (1987).

Poizner et al (1987) noted that the three left hemisphere damaged patients were aphasic for sign language but that their sign language impairments were not uniform. One left hemisphere patient (Gail D) was grossly impaired. Her signing output was nonfluent and limited to single signs in an utterance. Her language profile was identical with that of hearing Broca's aphasics. The second left hemisphere lesioned patient (Karen L) presented with fluent signing, exhibiting a full range of grammatical structures. Her deficits in expression were confined primarily to impairment at the sublexical level. She also presented with impaired comprehension. The third left hemisphere lesioned patient (Paul D) also displayed a fluent signing output. However he presented with an expressive sign language deficit primarily exhibited in the form of an abundance of paragrammaticisms, and failed to use the spatialised syntax of ASL (pronominal indexes and verb agreement markers). For a more detailed report and discussion of these three left hemisphere damaged cases, see Poizner et al (1987).

From an analysis of the sign language impairments presented by the three LDD subjects in this study, it can be seen that their sign language profiles most closely resembled that of the second left hemisphere patient, Karen L. Like Karen L, the three LDD subjects presented with fluent signed output exhibiting a range of grammatical markers. However they all presented with comprehension deficits, with LDD3 and Karen L showing a more marked comprehension deficit across the four subtests of the BDAE. The results of the three LDD subjects and Karen L performance on the BDAE comprehension subtests were supported by their poor performance on some of the formal sign language tests. Impairment in the ability to comprehend signs of a nonspatial derivational type was demonstrated by Karen L and LDD1 and 3. LDD2, like Karen L, displayed difficulties

in the comprehension of spatially realised grammatical relations. LDD1 and 3, however, only showed difficulty in extracting syntactic relations when there was a shift in reference. They all displayed impairments at retrieving signs at the lexical level. LDD1 and 3, like Karen L, showed difficulties in the repetition of signed sentences especially when the material became more lengthy and unfamiliar.

Unlike Karen L but similar to Paul D, LDD1 and 2 appeared to present with some spatial syntactic breakdowns in sign, as noted in their spontaneous signing. LDD1, like Paul D, had a high percentage of nouns in his discourse production and little use of verb agreement. LDD2 used a high percentage of pronouns and demonstrated little use of verb agreement. As with Paul D, the spatial syntactic breakdown in signing for LDD1 and 2 converges with their poor performance on the verb agreement subtests and implies a deficit not only in the production of spatial syntactic relations but also in the comprehension of these relations.

In this chapter the results of all subjects on the linguistic and cognitive test batteries have been presented and discussed. In addition comparisons were made between sign language impairments of the learning disabled subjects in this study and those of three left hemisphere lesioned patients in a study by Poizner et al (1987). In the next and last chapter a more general discussion will be undertaken and the implications of this study outlined.

CHAPTER SIX
GENERAL DISCUSSION, CONCLUSIONS AND IMPLICATIONS

In this chapter a general discussion concerning the dissociation of language and nonlanguage visuospatial functions and facial processing is undertaken. Summary profiles of the linguistic and cognitive skills of the three LDD subjects are presented. Finally, general conclusions are drawn and implications for future research outlined.

6.1 DISSOCIATION OF LANGUAGE AND NONLANGUAGE VISUOSPATIAL FUNCTIONS

This section discusses the dissociation of language and nonlanguage visuospatial functions. In this study the performance of two subjects across cognitive and linguistic tasks supports the dissociation of language and nonlanguage visuospatial functions found by Poizner et al (1987). However it is believed that at this stage still no firm conclusions can be made.

In sign language, linguistic and spatial relations participate in the one channel. Spatial contrasts and manipulations occur structurally at all linguistic levels in sign. Sign language integrates both complex linguistic structures and complex spatial relations, hence exhibiting properties for which left and right hemispheres, respectively, have shown predominant functioning (Poizner et al, 1987). Poizner et al (1987) noted that for processing spatialised syntax, complex underlying nonlanguage prerequisites are required: processing spatial relations (spatial loci), spatial memory (association of nominals with spatial loci and perception of memory for direction of movement of the verb between spatial endpoints) and spatial transformations (changes in spatial referential framework). Thus a deficit in the ability to process any of these underlying spatial cognitive prerequisites may result in impaired performance in the processing of spatialised syntax.

They also note that different functions may be essential for the production as compared to the comprehension of spatialised syntax. According to Poizner et al's (1987) findings, patients with right hemisphere lesions produced errorless signing including spatialised

syntax and discourse, which is evidence that the linguistic function, which requires mostly left hemisphere processing, is the more basic one here. However they claim that the perceptual processing required for the comprehension of spatialised syntax involves both the left and the right hemispheres and therefore certain crucial areas in both hemispheres must be intact for accurate processing. The right hemisphere would be involved with respect to the spatial nature of the units of perception and the left hemisphere would be involved regarding the linguistic nature of the underlying representations.

Poizner et al (1987) argue that the reason for any of their left hemisphere lesioned signers performing poorly on the comprehension of spatialised syntax may be the grammatical nature of the constructs involved, whereas in the case of the right hemisphere lesioned subjects it may be a result of the spatial nature of the perceptions.

A summary of the subjects' performance across both nonverbal and verbal spatial tasks can be seen in Table 6.1.

Table 6.1: Results across nonverbal and verbal visuospatial tasks

	C1	C2	C3	LDD1	LDD2	LDD3
Nonverbal Visuospatial Functioning	✓	✓	✓	✓	x	✓
Verbal Visuospatial Functioning: Comprehension						
verb agreement with a fixed framework	✓	✓	✓	✓	x	✓
verb agreement with a shifting reference	✓	✓	✓	x	x	x
Verbal Visuospatial Functioning: Production	✓	✓	✓	x	x	✓

✓ = intact functioning; x = impaired functioning

In this study LDD1's performance on the nonlanguage spatial tests and in the production and comprehension of spatialised syntax supports Poizner et al's (1987) findings of a dissociation of nonlanguage and language spatial functions. LDD1 showed intact nonlanguage visuospatial abilities in his performance on specific tests in the cognitive test battery. However he displayed a deficit in the productive use of space in his signing and an impairment in the comprehension of spatial transformations (Verb Agreement with a Shifting Reference Test). A possible explanation for his impaired performance in both comprehension and production of spatialised syntax could be based on a general linguistic deficit rather than any visuospatial deficit per se.

Unlike LDD1, who presented with a dissociation of language and nonlanguage functions, LDD2 did not present with this dissociation of functions. He presented with a nonlanguage visuospatial impairment as well as impairments in both comprehension and production of spatialised syntax. Moreover he showed a more marked deficit in the comprehension of spatial syntactical relations than LDD1, as determined by his poor performance on both Verb Agreement Tests, i.e., with a fixed framework and with a shifting reference. His more marked comprehension deficit could possibly be explained by Poizner et al's (1987) claim that the perceptual processing in the comprehension of spatialised syntax involves both the left and right hemispheres and therefore certain crucial areas in both hemispheres must be intact for accurate processing.

Although the findings of a dissociation of language and nonlanguage functions in this research supports the dissociations found by Poizner et al (1987), it is believed that, at this stage, no firm conclusions concerning dissociations of this nature can be made. It would be necessary to establish greater certainty concerning right hemisphere specialisation in the domain of visuo-spatial function first.

As Servos and Peters (1990) noted, the mere identification of a stimulus as of a visuo-spatial nature does not at this stage allow any predictions as to how the hemispheres react to it. Research using stimuli such as form localisation and enumeration, line curvature, line slant, perception of clock faces and human faces indicated a right hemisphere advantage (Servos and Peters, 1990). Work with geometric forms yielded less clear results and, nonsense forms showed that observed laterality is a complex function of

stimulus parameters. Similarly, unclear results were obtained with stimuli involving depth perception. Furthermore, with regard to mental imagery, there is little evidence of a right hemisphere advantage and some studies have even suggested a left hemisphere advantage (Servos and Peters, 1990).

As noted by Servos and Peters (1990), considering the variety of results, any simple overriding assertion of a right hemisphere advantage for visuo-spatial function is inappropriate. Hence before any conclusions can be reached about a dissociation of language and nonlanguage functions, further research in the area of lateralisation of visuo-spatial function is required. This would be emphasised when one attempts to explain the role of each hemisphere in the production and comprehension of sign language in which linguistic and spatial relations are integrated. Moreover, in any future research, a greater weight of testing using multiple tests of a visuo-spatial nature, than was employed in the present research, would be necessary in order to draw more firm conclusions.

6.2 FACIAL PROCESSING

Much research on normal hearing subjects and hearing patients with brain damage has been conducted in the recognition of the identity of faces and the perception and production of facial expressions of emotion. To the best of the writer's knowledge, however, no research has been conducted on the perception of facial expressions used for linguistic purposes in sign language nor on the breakdown of both the perception and production of such facial expressions. The study of the breakdown in facial processing in sign language is particularly intriguing in that it unfolds the relationship between higher order cognitive and linguistic functions.

Research on both nondisabled subjects and patients with brain damage suggests a special role for the right hemisphere in the processing of facial information (Benton, 1980, cited by Rapscak et al, 1989). A considerable amount of research has found that the right cerebral hemisphere is superior to the left in the recognition of the identity of faces (Hilliard, 1973; Klein, Moscovitch and Vigna, 1976; Levy, Trevarthen and Sperry, 1972; Ley and Bryden, 1979; Rizzolatti, Umilta and Berlucchi, 1971; De Renzi, 1986); in the

perception of facial expressions of emotion (Cicone, Wapner and Gardner, 1980; De Kosky, et al, 1980; Ley and Bryden, 1979; Strauss and Moscovitch, 1981; Borod, Koff and Caron, 1983; Borod, Koff, Perlman Lorch and Nicholas, 1986); and in the production of facial expressions (Borod et al, 1986). In the course of investigations of the processing of facial information some dissociations have become evident. Rapscak et al (1989) cite numerous studies in which dissociations have been found between the identification of familiar and unfamiliar faces and dissociations between the processing of facial identity and the analysis of emotional facial expressions. Rapscak et al (1989) state that, according to the results of tachistoscopic laterality studies in normal individuals, the tasks of analysing facial identity and expression are independent of each other although the right hemisphere makes an important contribution to both functions.

The results from this study may provide some evidence regarding further dissociations involving the perception and production of facial expressions conveying linguistic information in sign language. Unlike the studies documented in the literature, which have investigated the perception and production of affective facial expressions, this study has focused on facial expressions which convey true linguistic information in sign languages. Unfortunately, due to the scope of this study, investigation of the perception of facial expressions used for affect as opposed to a true linguistic function was not undertaken. Hence from these results it cannot be determined whether these two functions are dissociated or not. However, as discussed in Chapter Two, the evidence from studies conducted on the acquisition of facial expressions in sign in the deaf population indicates that affective knowledge of facial expressions initially serves as a transition into the facial morphology of sign language (Reilly, McIntire and Bellugi, 1990). Hence the perception of facial expressions for affect and the perception of facial expression with a true linguistic function in sign may involve a single mechanism or at least an interdependent mechanism. Research is still required regarding the relationship between the processing and production of facial expressions for affect and facial expressions conveying linguistic information in sign in normal and brain damaged deaf persons.

In this research, the subjects' ability in the recognition of facial identity and the perception and production of facial expressions conveying linguistic information in sign language was examined. The Benton Facial Recognition Test was used to examine the

recognition of facial identity of unknown faces. Three Grammatical Facial Expression Tests were developed and administered to all subjects to examine their perception of facial expressions conveying linguistic information in sign. The production of facial expressions as a linguistic function was examined in the subjects' narrative discourse samples. A summary of each subject's performance across these various tests is presented in Table 6.2.

Table 6.2: Summary of subjects' performance on the recognition, perception and production of facial expressions

	C1	C2	C3	LDD1	LDD2	LDD3
Recognition and Perception						
Benton Facial Recognition Test	✓	✓	✓	✓	✓	x
Name the Grammatical Facial Expression Test	✓	✓	✓	✓	x	x
Choose the Correct Facial Expression Test	✓	✓	✓	✓	✓	x
Production	✓	✓	✓	✓	x	x

✓ = intact functioning; x = impaired functioning

As can be seen from Table 6.2 all control subjects and LDD1 performed well on the Benton Facial Recognition Test and the Grammatical Facial Expression Tests and also demonstrated effective use of facial expressions in their narrative productions. All subjects performed well on the Same/Different Facial Expression Discrimination Test. However, as noted in Chapter Five, this test appears to lack sensitivity in tapping deficits in the recognition of facial identity and thus will be excluded from the discussion below.

As mentioned in Chapter Five, the results of LDD2's performance on the battery of tests may prove to be particularly interesting and provide support for the findings reported by Bowers and Heilman (1984, in Rapscak et al, 1989) and those reported by Rapscak et al (1989). They reported the findings of subjects who presented with an anomia for facial expressions. LDD2's preserved functions regarding the recognition of facial identity as

well as the recognition of grammatical facial expressions, in conjunction with his impaired ability to name the target facial expression, appears to resemble the deficit described by Rapscak et al (1989), which is an anomia for facial expressions induced by a visual-verbal disconnection. Whether LDD2's deficit in naming facial expressions would still persist in the case of naming facial expressions used for affect, as was examined by Rapscak et al (1989), needs further investigation.

Unlike LDD2, LDD3 performed poorly across all tests, showing a severe impairment in the recognition of unknown faces, as well as difficulties in the recognition, identification and naming of grammatical facial expressions and also in the production of such expressions. Unlike LDD2, his deficit was not confined to an inability in naming but rather appeared to present as an agnosia for facial processing including an inability to recognise facial expressions used for linguistic purposes in sign. Although LDD3's performance on the above-mentioned tests did not provide us with further evidence regarding a dissociation of functions, it may provide support for a superior role of the right hemisphere in the processing and production of grammatical facial expressions. Findings from an EEG completed earlier in his life indicated a maturation defect in the right fronto-central and temporal regions. However, although there appeared to be support for a right hemisphere involvement accounting for his deficit in the recognition of faces and grammatical facial expressions, and his poor production of grammatical facial expressions, it still cannot be ruled out that a left hemisphere involvement may contribute to his deficit. Hamsher et al (1979, in Benton, 1985) noted that aphasic patients with left hemisphere damage and a significant comprehension deficit also showed failure in facial discrimination. It is proposed that the accurate processing of facial information and more particularly facial expressions in sign language would require certain crucial areas in both hemispheres to be intact.

The findings from this study indicate that the perception and production of facial expressions in sign language may be independent of each other. Although LDD3 presented with apparent deficits in both the production and perception of grammatical facial expressions, LDD2 presented with a dissociation of functions in this regard, in that his recognition of facial expressions in sign was found to be intact, whilst his production appeared to be impaired. Similar findings concerning the dissociation of the perception

and production of emotional facial expressions have been documented. Studies of the production as compared to the perception of emotional facial expression in brain damaged patients are less common. From the studies completed on the production of emotional facial expressions it appears that, as for the perception of such expression, there is a special role for the right hemisphere (Borod et al, 1986). Borod et al (1986) examined the perception and production of emotional facial expressions within the same individuals. Although they found a greater right hemisphere involvement with both perception and production of posed and spontaneous emotional facial expressions, they found negligible correlations between expression and perception variables, suggesting that these two performances may be tapping relatively separate aspects of emotional processing. Further research within the nondisabled deaf population and with brain damaged deaf patients concerning the perception and production of both facial expressions used for affect and those used for linguistic purposes is still required.

6.3 SUMMARY PROFILES OF LINGUISTIC AND COGNITIVE SKILLS FOR THE THREE LEARNING DISABLED DEAF SUBJECTS

The particular combination of test batteries and tasks used in this study has allowed for a comprehensive account of each subject's linguistic and cognitive profiles. It revealed linguistic and cognitive deficits in the three LDD subjects which were not evident in the control subjects. Furthermore it highlighted the similarities as well as the heterogeneity of the three LDD subjects' linguistic and cognitive profiles in terms of both the nature and degree of severity of the deficits. It has also proven to be sensitive to some of the more subtle linguistic deficits which have been previously documented in the adult hearing learning disabled population. In addition it revealed deficits in some of the underlying processes of sign language such as spatial processing and facial processing, as well as its manifestations in various forms.

Table 6.3: Summary profiles for the three learning disabled subjects indicating preserved ability and deficit in various cognitive and linguistic functions

	COMPREHENSION							EXPRESSION				COGNITIVE				
	word	sentence & story level	spatial syntax		non-spatial	facial recog. & naming	facial recog.	facial expression	spatial	reference - verb agreement	evaluation	attention	verbal memory	non-verbal memory	SAWAIS Block Design	Benton Facial Recog. Test
			fixed	shifting												
LDD1	✓	x	✓	x	x	✓	✓	✓	x	x	✓	x	x	x	✓	✓
LDD2	✓	x	x	x	✓	x	✓	x	x	x	x	✓	x	x	x	✓
LDD3	x	x	✓	x	x	x	x	x	✓	✓	x	x	x	x	✓	x

✓ = intact functioning, x = impaired functioning

●	facial
●	spatial

As can be seen from Table 6.3, similarities in the nature of the LDD subjects' linguistic and cognitive deficits were noted in their deficits of comprehension of signed material on a sentence and a story level, vocabulary deficits, disruptions in referencing and deficits in verbal memory. However some of the major differences between the subjects lay in the areas of spatial and facial processing.

In summary, whereas LDD1 presented with a partial impairment in the comprehension of spatial relations and a breakdown in the productive use of space, he showed intact processing and production of facial information in sign. Conversely, although LDD3 showed some difficulties in appreciating spatial syntactic relations, his productive use of space was intact. However he revealed a severe deficit in the perception and production of facial expressions in sign language. On the other hand LDD2 showed a severe deficit in the comprehension and production of spatial relations as well as a category-specific naming impairment - that of naming facial expressions in sign language - and a deficit in the production of facial expressions. Although no explanation could be provided from the objective analysis for the lower coherence rating obtained by LDD2 than LDD1 and 3 on the narrative discourse task, the sign language impairments resulting from his deficits in spatial and facial processing may have resulted in a less well formed text and hence a lower rating for coherence.

A breakdown in the use of space by LDD1 and 2, and poor use of facial expressions by LDD2 and 3 were observed within the narrative discourse task. LDD1 and 2 were rated as showing little clarity concerning the demarcation of physical locations within their signing space and the assignment of nominals within those spaces as related to the particular narrative. In addition, the types of referential disruption shown by LDD1 and 2 reflected their deficits in the effective use of space in their signing. Both LDD1 and 2 displayed little use of verb agreement as a cohesive device.

LDD2 and 3's poor use of facial expressions was reflected not only on a grammatical level, but also on a superstructural level in their narrative discourse productions. It is speculated by the writer that the ability to use facial expressions effectively in sign is reflected not only on a grammatical level but also in the superstructure in discourse, more specifically in the evaluative elements in discourse. This speculation is based on the

proposed relationship between the use of facial expressions and the use of evaluative elements in discourse. It is the writer's suggestion that facial expression is the main mechanism involved in the expression of evaluative elements in signed discourse. Although, as has been mentioned previously, hearing learning disabled persons have shown difficulties in adopting and expressing evaluative elements concerning the characters of a story, it is believed that in sign language the use of evaluative elements in discourse will also require effective use of facial expressions. Moreover, this argument is strengthened when one considers that the use of evaluation in narrative discourse is what makes a story "worth telling" and "full of interest" and that signers who use facial expressions effectively are recognised as being "good" or "interesting" signers. Both LDD2 and 3, who showed a deficit in the use of facial expressions, also used few evaluative elements in their discourse productions compared to the control subjects and LDD1.

The results from the cognitive test battery generally showed lower scores across the range of cognitive tasks for LDD2 than the other two LDD subjects. Many of these lower scores are accounted for by his reported "average" IQ. However on certain tasks his low scores could not be accounted for by his IQ, but rather would indicate a cognitive deficit. In addition his reported average IQ could not account for his linguistic deficits. Similarities and differences in performance on the various cognitive tasks were found among the three learning disabled subjects. All three LDD subjects showed a possible deficit in short-term verbal memory. Their difficulties in verbal memory are believed to contribute to their difficulties shown in comprehension, repetition tasks and vocabulary. In addition all subjects showed a deficit in the serial recall of well-learned linguistic information, as was determined on the Automatised Sequences subtest of the BDAE. These findings support the findings, well-documented in the literature, of serial recall deficits of linguistic information in the learning disabled hearing population. Whether this deficit reflects a difficulty in storage or retrieval needs further investigation. Another similarity noted was their deficits in nonverbal short-term memory; however, LDD2 did show a more marked impairment than the other two LDD subjects.

On the cognitive test protocol, differences were noted in attention, visuoconstructional functions and facial recognition. LDD3's defective attention span and LDD1's fluctuating

attention span may account for their greater difficulty than LDD2 on linguistic tests such as the Repeating of Phrases and Sentences subtest of the BDAE. LDD2's nonlanguage spatial deficit, shown on the SAWAIS Block Design Test and in the Recall of the Rey Complex Figure, would support the findings of his more severe comprehension deficit involving spatial relations in sign. LDD3's poor performance on the Benton Facial Recognition Test converged with his poor performance on the other facial processing tests in this study.

6.4 GENERAL CONCLUSIONS

In conclusion, in this study a tool to investigate sign language impairments in the learning disabled deaf population was devised. The tool was found to be sensitive in that it tapped various levels of language and cognition which are relevant in the investigation of sign language impairments. The batteries of subtests assessing comprehension, facial processing and spatial processing were found to be particularly useful in the diagnostic process. The comprehension battery incorporated a wide range of subtests which allowed for the assessment of the comprehension of signed material on various levels and included aspects of spatial and nonspatial and facial processing. The inclusion of numerous subtests and tasks which tap not only the perception but also the production of spatial and facial processing skills was considered to form an integral part of the assessment process as these aspects are unique to signed languages and are important underlying processes to sign language competence.

The cognitive test protocol allowed for the examination of the cognitive functioning of each individual subject. In addition it assisted in describing the relationship between cognition and language and provided more insight into the nature of certain underlying sign competencies such as spatial processing.

The inclusion of a signed narrative discourse task as part of the test battery and the particular methods of analysis thereof allowed for the examination of higher order linguistic and cognitive skills and specific aspects of sign language which had not been previously investigated. Moreover it revealed relationships between some of the

underlying processes of sign language and their role in higher level linguistic behaviours such as referencing and evaluation in discourse.

The extent to which this battery may be adopted with confidence is felt to be good because of numerous factors. Firstly, it involved deaf people in all stages of the research. Secondly, high reliability was obtained in the transcription, rating and scoring of the narrative discourse tasks. Thirdly, it seemed sensitive in distinguishing between nondisabled and language impaired learning disabled deaf individuals.

In this study, as opposed to the research conducted by Poizner et al (1987), in which sign language and cognitive skills in brain damaged deaf adults were investigated, cognitive aspects such as attention and memory, reflecting more general cognitive functioning, were examined. Hence it allowed for further explanations and interpretations of the subjects' linguistic impairments. In addition, unlike in Poizner et al's (1987) study, the subjects' abilities in the perception and production of facial expressions and other nonmanual behaviours were examined.

The type of tool used in this study to identify sign language impairments has aided in the identification of the language impaired learning disabled deaf individual. This in turn has numerous implications for their identification and remediation. It allows for the clearer identification of a deaf person with a "general language" impairment as opposed to the deaf person who presents with intact sign language and a deficit merely in spoken language. It is believed that sign language should form the focus of the assessment and less emphasis should be placed on spoken language in the assessment and remediation process. In addition, within the assessment of sign language, deaf people should be involved in both the adminstration and analysis of test results. Impairments identified in some of the underlying cognitive and linguistic processes should form the basis of the remediation programme. Furthermore it is suggested that some of these processes underlie both signed and spoken language. The benefits of remediation would therefore be seen in both languages.

Briefly, a suggested therapy programme for the LDD subjects in this study would include remediation of underlying processes in sign language, such as memory, nonverbal spatial

processing, spatial processing and facial processing. In addition, therapy would focus on improvement in word retrieval skills, increasing spans of vocabulary, and skills involved in the superstructure of discourse such as referencing and evaluation. More specifically, when remediating the use of referencing and evaluation in signed discourse, stories should be used as the medium of teaching, and the subject should be assisted in recognising their ambiguities which result from referential disruptions and positive compensations should be encouraged. Furthermore, encouragement of the adoption of the roles and feelings of the main characters in stories and the expression thereof should also be included in the therapy programme.

6.5 THEORETICAL IMPLICATIONS

Parallels between the linguistic and cognitive impairments of the LDD subjects in this study and those of the language impaired learning disabled hearing population (see Wiig et al, 1977) have been noted. This in turn implies that the breakdown in linguistic and cognitive skills typically found in the language impaired learning disabled population is independent of hearing status and the modality of language. Furthermore, this provides further support to the notion that there are underlying processes which are common to both signed and spoken languages.

In addition to the skills already identified by researchers such as Bellugi et al (1987) as essential for sign language, we should remember how crucial certain others are, perhaps heretofore underplayed in the literature. The use of facial processing and other nonmanual behaviours in sign language has been well researched and documented in terms of their acquisition and their role on a grammatical level. However, to the writer's best knowledge, little or no research concerning the examination of their perception, the breakdown of such perception or their role in the macro/superstructure of discourse has been previously undertaken or documented. Studying the processing of facial information in sign language from both a linguistic and a neuropsychological perspective has expanded the way we view the processing of facial information in general as well as the role of facial expression in sign language, heretofore considered from a more limited perspective in the literature.

This study recognised the relationship between certain cognitive skills and the processing of sign language. Moreover a consideration of each subject's cognitive skills was undertaken when attempting to interpret observed sign language impairments. Studying the breakdown in sign language from a psycholinguistic perspective has allowed us to identify some of the more crucial underlying processes essential to sign language competence.

6.6 IMPLICATIONS FOR FUTURE RESEARCH

Numerous research implications have emerged form this study, many of which have been mentioned throughout the study. However, in this concluding section some of the major future research implications will be outlined.

A future research implication that has been highlighted throughout this study is the dire need for further research in SASL. This is emphasised further when one considers the future role of SASL in the education of the deaf, and the implications for SASL derived from the development of a sound language policy by the South African Government of national unity. As has been noted by Penn and Reagan (1995), although in its current form ANC education language policy does not explicitly discuss SASL, three general principles can be applied in the case of the deaf. They have been articulated in a discussion document, A Policy Framework for Education and Training, issued by the Education Department of the ANC, on which sound educational language policy must be based (ANC, 1995 cited by Penn and Reagan, 1995).

These three principles are:

(1) The right of the individual to choose which language or languages to study and to use as a language of learning (medium of instruction).

(2) The right of the individual to develop the linguistic skills, in the language or languages of his or her choice, which are necessary for full participation in national, provincial, and local life.

(3) The necessity to promote and develop South African Languages that were previously disadvantaged and neglected (ANC, 1995, p.63 cited by Penn and Reagan, 1995, p.12).

As has been proposed by Penn and Reagan (1995), if these principles were applied in the case of the deaf, the first and second principles in essence would imply that the deaf child should be entitled to what some educators of the deaf have termed a "bilingual-bicultural educational programme' in which both signed and spoken languages are employed. The third principle would advocate the recognition of SASL as an official language, the promotion of a common lexicon for SASL, the teaching of SASL to teachers of the deaf and other professionals involved with the deaf, and the raising of public awareness of SASL.

Hence an extensive amount of future research in SASL is now required, considering the possible future status of SASL in South Africa and its role in the education of the deaf, and, that formal research of SASL dates only form the early 1980's (see HSRC, 1983).

Another major implication that has emerged form this study is the need for the development of additional tools to assess SASL skills and other cognitive related functions in the deaf population in South Africa. As previously noted in Chapter 3, the test instruments used to determine the intellectual capacity of deaf individuals in general, and their use in predicting achievement, and other criteria have been seriously questioned. Furthermore, as has been noted by Nell (1994), within the South African hearing population the use of a commonly used instrument such as the SAWAIS is not in the public interest and the capability certainly exists in South Africa for the development of innovative and culturally appropriate ability assessment devices. The development of such devices for the assessment of cognitive processes and ability in South African deaf individuals is clearly needed.

In addition, the need to obtain normative data concerning the particular assessment tool used in this study, and other assessment tools in general, within the non-disabled, learning disabled and other neurologically impaired deaf population groups is clearly highlighted. Furthermore, while testing in South Africa, sensitivity to the various racial and cultural groups to which the deaf individual belongs is required, and the development of separate norms for separate groups is deemed necessary. As Verster, 1986; Verster and Prinsloo, 1988 (in Nell, 1994, p.107) notes, "To move beyond race and culture, one must first deal openly with the value and cognitive style that race and culture mediate".

The racial and cultural diversity found in South Africa may in itself provide an excellent 'testing ground' for future cross cultural research. Investigations of linguistic and cognitive functions of deaf persons from differing racial and cultural groups may indeed throw light on the issue of the status of linguistic and cognitive universals which are engaging increasing attention in cross-cultural literature.

It is proposed that future research replicating the methodology used in this study, but with a comprehensive battery of cognitive tests of the scope customarily used in a full neuropsychological assessment in sophisticated settings, be undertaken. This would allow for target functions to be evaluated with a multiplicity of convergent measures which would contribute significantly to an understanding of the cognitive processes required for the comprehension and production of sign and the breakdown of sign in the presence of learning disabilities.

Furthermore, the breakdown of sign language needs to be studied in other neurologically impaired deaf population groups in order to provide additional information regarding the nature of sign language impairments. This in turn will provide us with additional information concerning the processes involved in sign language and, from a clinical perspective it will provide us with the correct identification and remediation procedures.

The results from the narrative discourse analysis of the learning disabled deaf subjects in this study seem to parallel the narrative discourse productions of other neurologically impaired hearing groups such as those with hypofrontal brain injury and those with right hemisphere damage. Future research involving a comparative study of spoken narrative discourse productions in hearing subjects and signed narrative discourse productions in deaf subjects with cognitive impairments may help to elucidate the mechanisms underlying disrupted narrative discourse productions.

Lastly, further investigation of spatial and facial processing in sign language within a particular subgroup of right hemisphere damaged deaf persons will shed more light on these underlying processes in sign language and the role of the right hemisphere in the processing of spatial and facial information.

> To equate speech with language is to obscure what is the nature of the linguistic systems which form the basis for all spoken languages and for all the signed languages used by communities of deaf persons throughout the world. As long as researchers concerned themselves only with spoken languages there was no way to separate what is essential to the linguistic cognitive system from the constraints imposed, productively and perceptually, by the auditory-vocal modality, that is to discover what is the genetically, biologically determined linguistic ability of the human brain. (Fromkin, 1988, p.116)

APPENDIX A

TEST INSTRUCTIONS AND EXAMPLES OF TEST ITEMS

In this appendix, instructions and examples of test items from some of the subtests used in this study are presented. A few examples are provided of test items from the subtests of the BDAE which required adaptation. Instructions and a few examples from each subtest of the Formal Sign Language Test Battery and instructions for the narrative discourse task will be displayed. Instructions and examples of test items from the subtests which were only translated are not given here as these can be obtained from the original test manuals. For the purpose of this appendix all graphics have been scaled down to a smaller size.

1. BDAE

Biographical Questionnaire

Some of the additional questions to those provided by Goodglass and Kaplan (1972) which were included in the Biographical Questionnaire are as follows:

- How often do you use sign language to communicate?
  never sometimes often always
- How old were you when you learned sign language?
- From whom did you learn sign language?

Sign Agility

Examples of signed test items: "like", "smell", "submarine"

Repetition of Words

Examples of test items: "shower", "red", "five"

Repeating Phrases and Sentences

Examples of high probability phrases and sentences:

- "Went to fill up my car"
- "I saw him on TV last night"

Examples of low probability phrases and sentences:

- "Turn over the tin lid"
- "Unripe grapes are sour"

Responsive Naming

- "What do we cut meat with?"
- "Where do you buy bread?"
- "What do we stir with?"

2. FORMAL SIGN LANGUAGE TESTS

2.1 Phonological Processing Tests

Rhyming Test

Instructions: "Look at the pictures and point to two of the pictures whose representing signs rhyme".

Prior to the subject pointing to the target pictures, the test administrator and the subject together sign the words representing each picture. One practice example is provided for each of the three sections (same handshape and same place; same handshape and same movement; same place and same movement).

Examples of test items are presented in Figure A1.

Test for Decomposition of Signs

Instructions: "I am going to sign a word and then I want you to point to the picture whose sign has the same handshape (place of articulation / movement) as the sign I made."

Prior to the test administrator signing the word for each test item, the test administrator and the subject together sign the words representing the pictures. One practice example was provided for each section (same handshape, same place of articulation, same movement).

Examples of test items are presented in Figure A2.

2.2 Morphological Processing Tests

Comprehension of Noun/Verb Distinction

Instructions: "I want you to point to the picture which represents the sign I make".

Prior to the subject pointing to the target picture, the test administrator and subject produce the signs for the four pictures.

Examples of test items are presented in Figure A3.

Elicitation of Noun/Verb Distinction

The subject is shown a picture of a noun or verb and then asked: "What is this?" (for a noun) or "What is he or she doing?" (for a verb).

Examples of test items are presented in Figure A4.

2.3 Spatialised Syntax Tests

Nominal Establishment Test

The test administrator assigns two or three nominals to specific loci in space. The subject is then asked two questions:
- "Where is the ...?" and
- "What (noun) was here?".

An example is presented in Figure A5.

Verb Agreement with a Fixed Framework

Instructions: "Choose the picture which corresponds to the sentence I am going to sign."

The grammatical relations are marked by the spatial points of the verb. The spatial arrangement of the nouns in the sentence need not match the spatial arrangement of the objects in the picture. An example is provided in Figure A6.

Verb Agreement with a Shifting Reference

The test administrator first signs a sentence involving two nominals, each with an associated spatial pronominal index and an action verb whose spatial endpoints mark the subject and the object of the sentence. The following two questions are asked in random order.
- "Who got ...?" (Who was the recipient of the action?)
- "Who did the ...? (Who was the agent of the action?)

The questions involve a shift in the spatial frame of reference relative to the test sentence. An example is provided in Figure A7.

2.3 Grammatical Facial Expression Tests

Name the Facial Expression

Instructions: "I am going to show you a photograph of a person's face. From the expression on the face, you must tell me if they are:

- asking a question
- expressing no or not (negative marker)
- showing enjoyment / relaxation, or
- showing inattention and lack of control."

A test card with the written words representing each of the four categories is displayed throughout the test.

Examples of test items are presented in Figure A8.

Choose the Correct Facial Expression

Four photographs of the same person, each representing one of the four categories of facial expression, are placed in front of the subject. The test administrator names a particular expression and the subject is required to point to the photograph that represents the expression named.

Instructions: "Choose the photograph which represents the facial expression named by me."

An example of a test item is displayed in Figure A9.

Same/Different Grammatical Facial Expression

Two photographs of the same person with either the same or different facial expression are placed in front of the subject.

Instructions: "Tell me if they are the same or different."

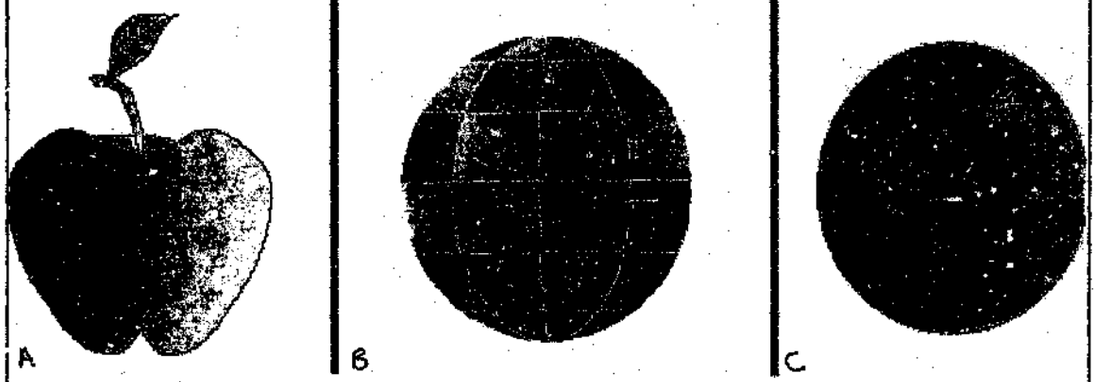
Examples are presented in Figure A10.

3. NARRATIVE DISCOURSE TASK

The subjects are presented with the wordless picture story "The Snowman" (Raymond Briggs, 1978).

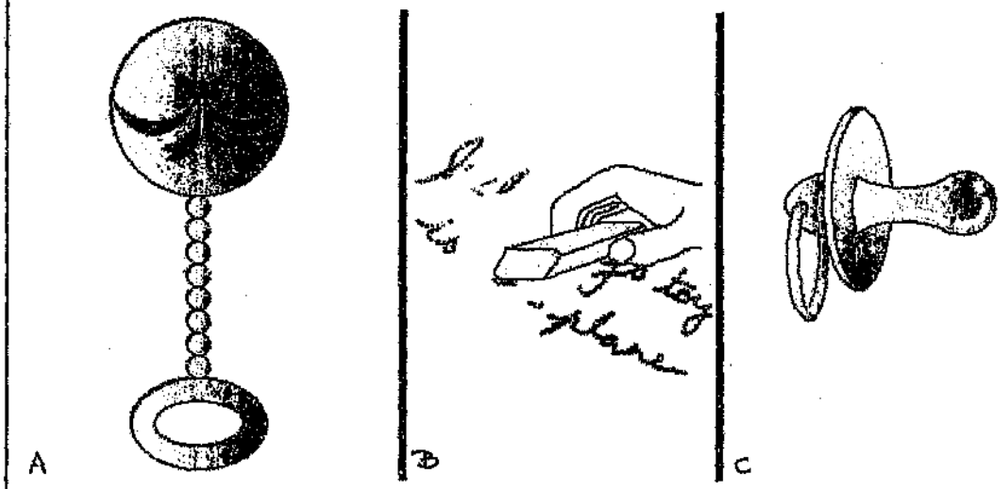
Instructions: "You are requested to follow the story and recall the story in as much detail as possible. You are then requested to retell the story as well as you can to me, as I have not 'seen' the story before."

SAME HANDSHAPE / SAME PLACE OF ARTICULATION



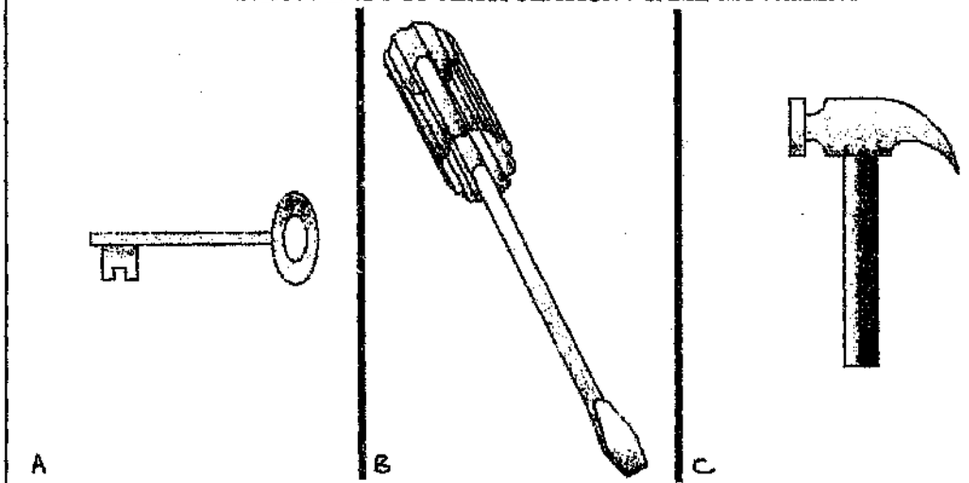
The correct choice is B and C because the signs for "ball" and "orange" share the same handshape and place of articulation

SAME HANDSHAPE / SAME MOVEMENT



The correct choice is A and B because the signs for "rattle" and "eraser" share the same handshape and movement

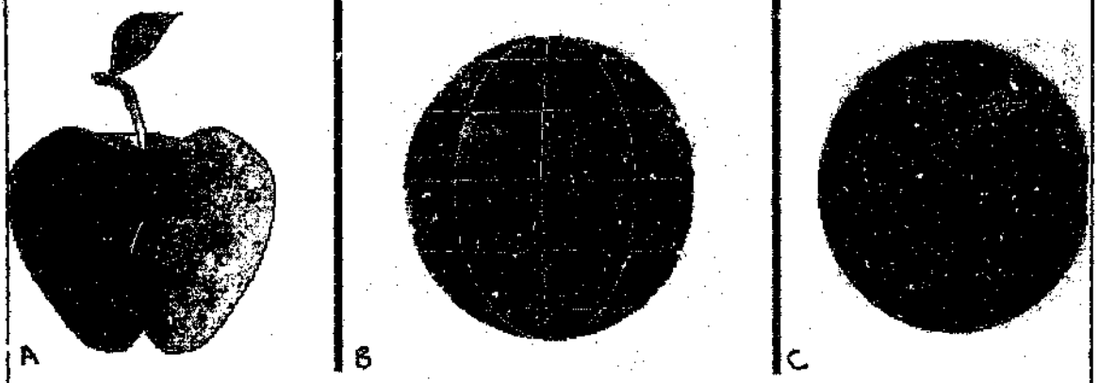
SAME PLACE OF ARTICULATION / SAME MOVEMENT



The correct choice is A and B because the signs for "key" and "screwdriver" share the same place of articulation and the same movement

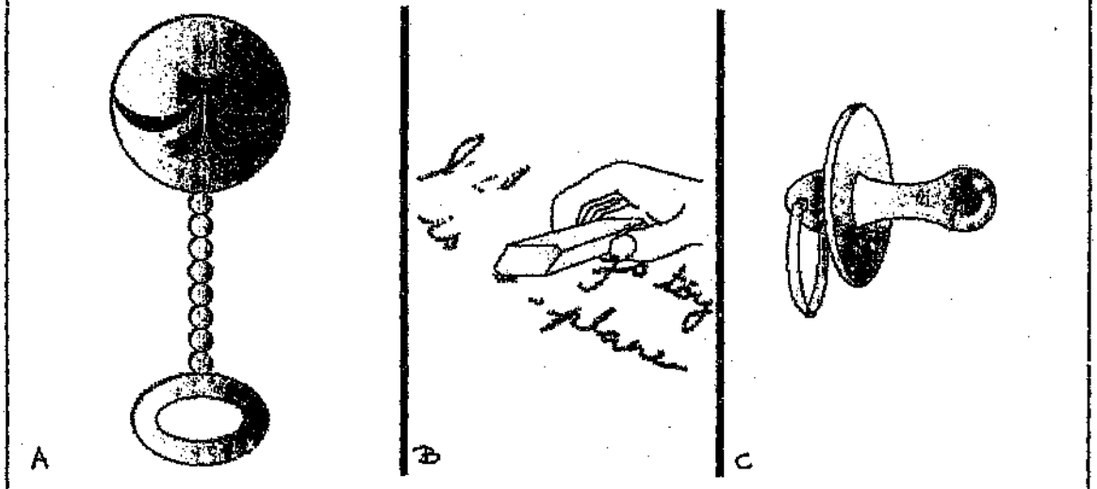
Figure A1: Examples of test items from the Rhyming Test

SAME HANDSHAPE / SAME PLACE OF ARTICULATION



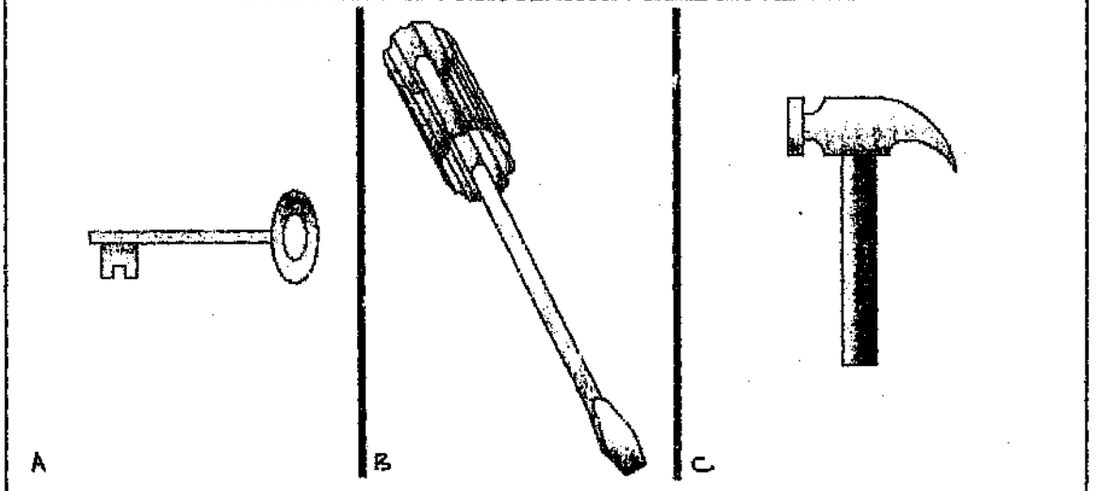
The correct choice is B and C because the signs for "ball" and "orange" share the same handshape and place of articulation

SAME HANDSHAPE / SAME MOVEMENT



The correct choice is A and B because the signs for "rattle" and "eraser" share the same handshape and movement

SAME PLACE OF ARTICULATION / SAME MOVEMENT

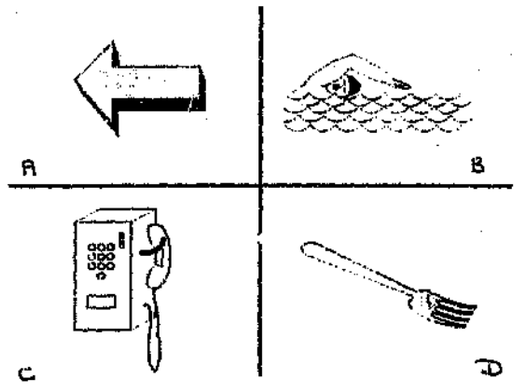


The correct choice is A and B because the signs for "key" and "screwdriver" share the same place of articulation and the same movement

Figure A1: Examples of test items from the Rhyming Test

TARGET HANDSHAPE

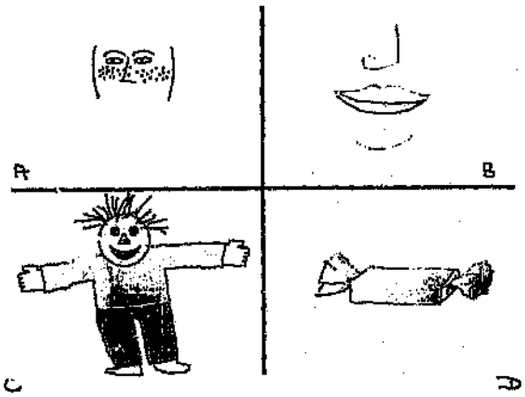
presented sign: "aeroplane"



The correct choice is C because the sign for "telephone" has the same handshape as the presented sign "aeroplane"

TARGET PLACE OF ARTICULATION

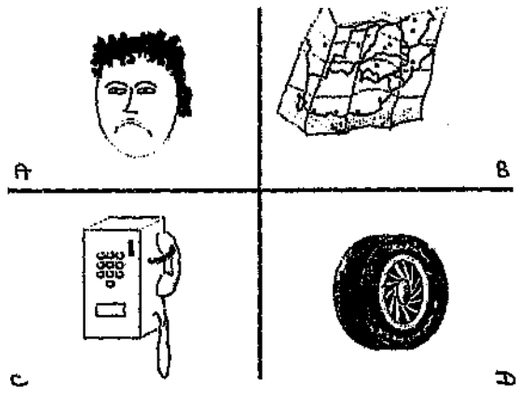
presented sign: "dimple"



The correct choice is D because the sign for "sweet" shares the same place of articulation as the presented sign "dimple"

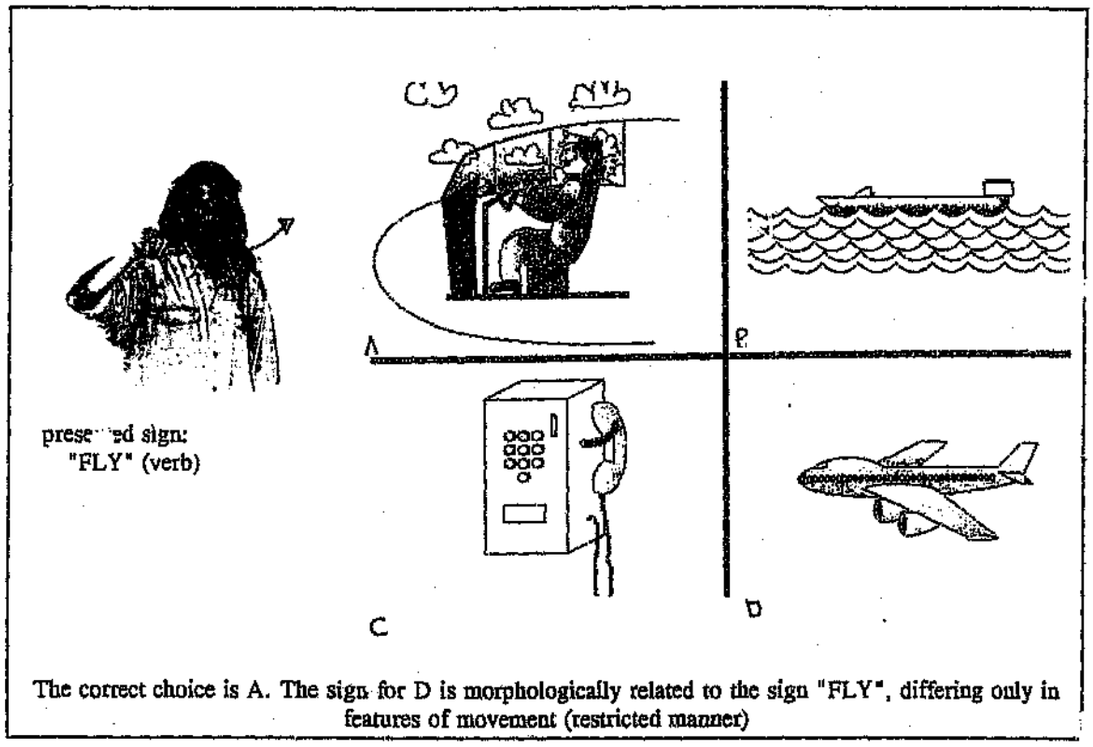
TARGET MOVEMENT

presented sign: "mad"

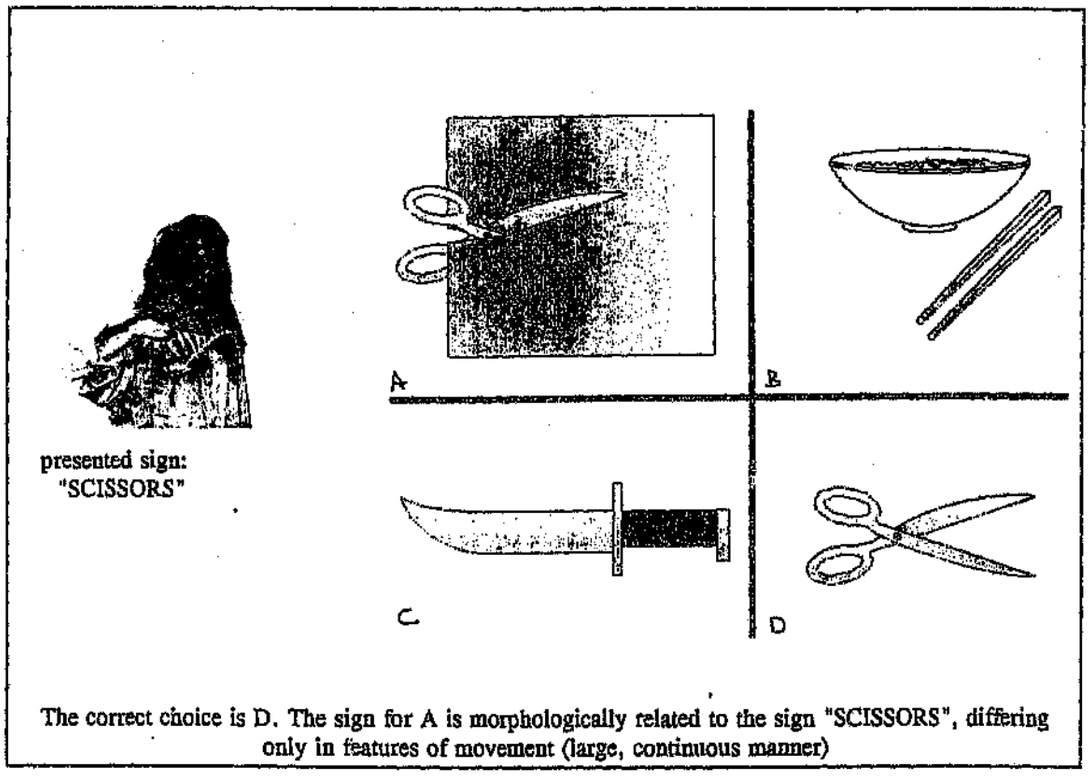


The correct choice is D because the sign for "wheel" has the same movement as the presented sign "mad"

Figure A2: An example of a test item for each major formational parameter from the Decomposition Test



The correct choice is A. The sign for D is morphologically related to the sign "FLY", differing only in features of movement (restricted manner)



The correct choice is D. The sign for A is morphologically related to the sign "SCISSORS", differing only in features of movement (large, continuous manner)

Figure A3: Examples of test items from the Comprehension of Noun/Verb Distinction Test

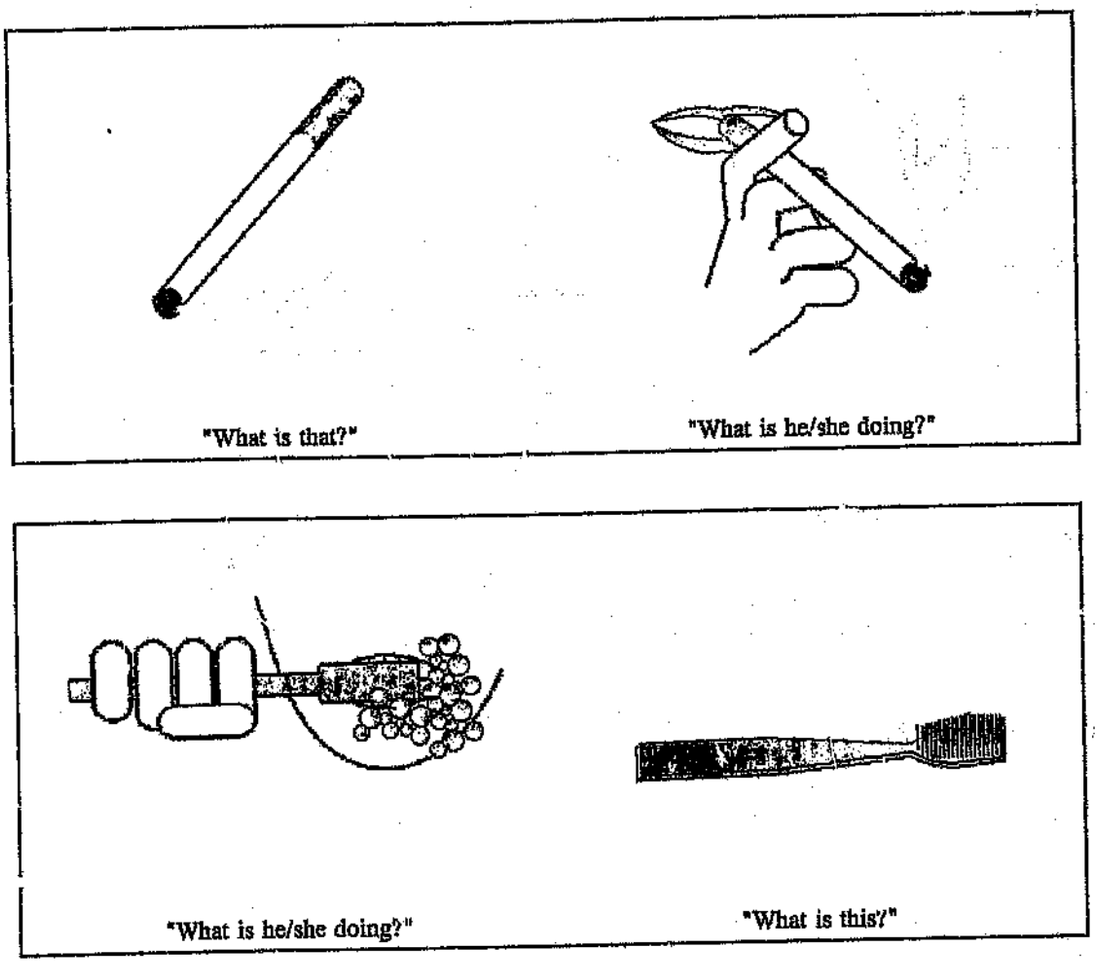


Figure A4: Examples of test items from the Elicitation of Noun/Verb Distinction Test

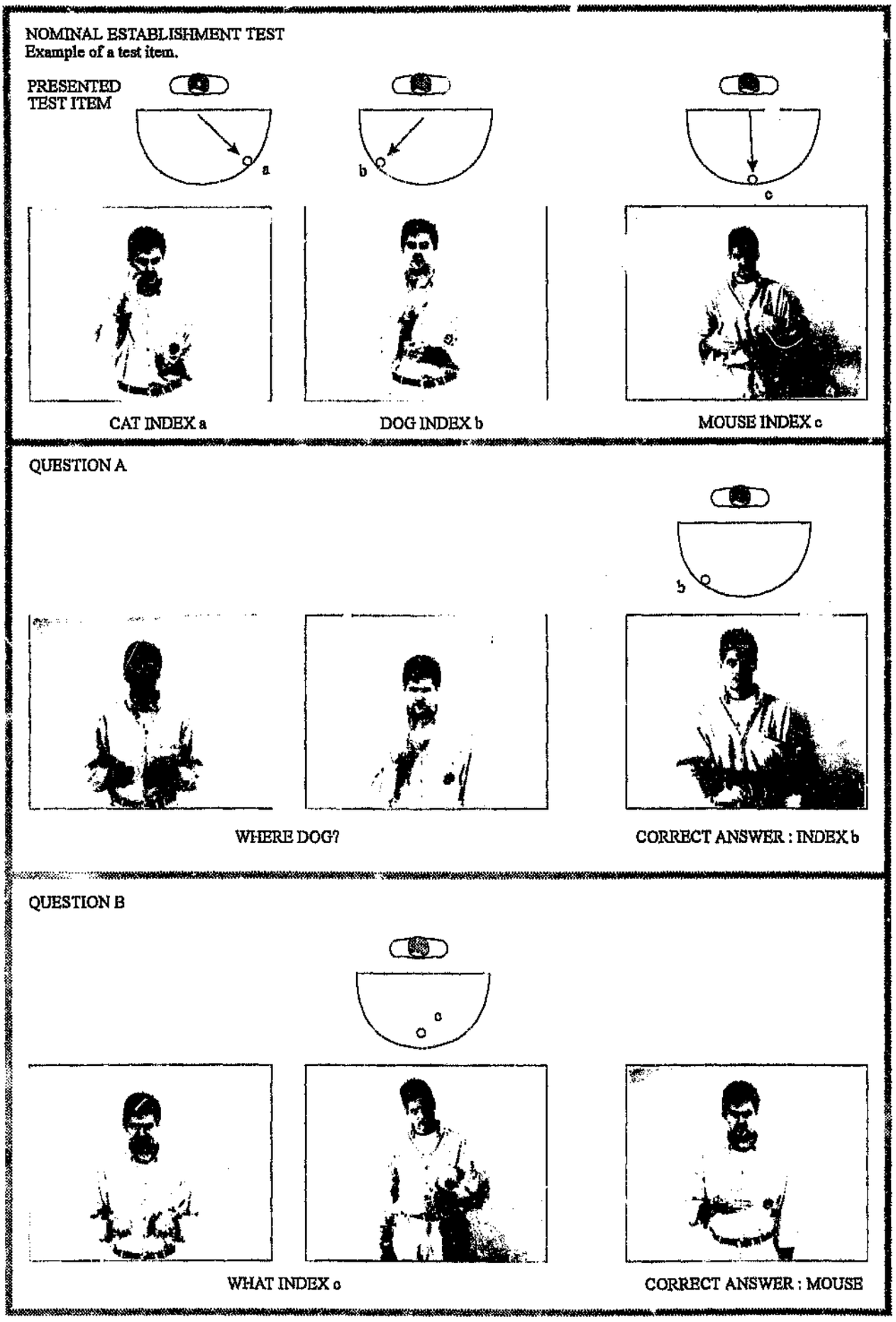


Figure A5: Example of a test item from the Nominal Establishment Test

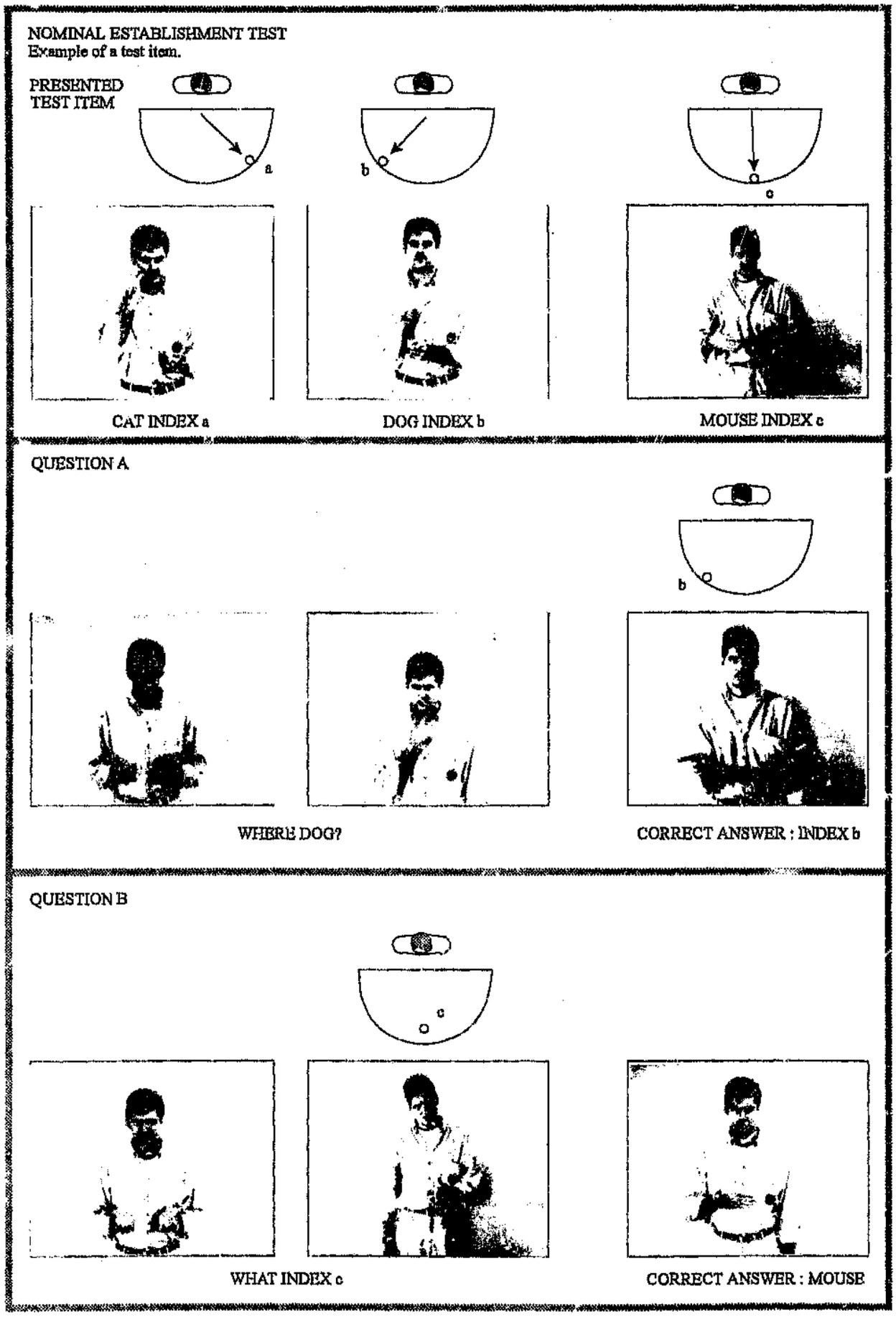


Figure A5: Example of a test item from the Nominal Establishment Test

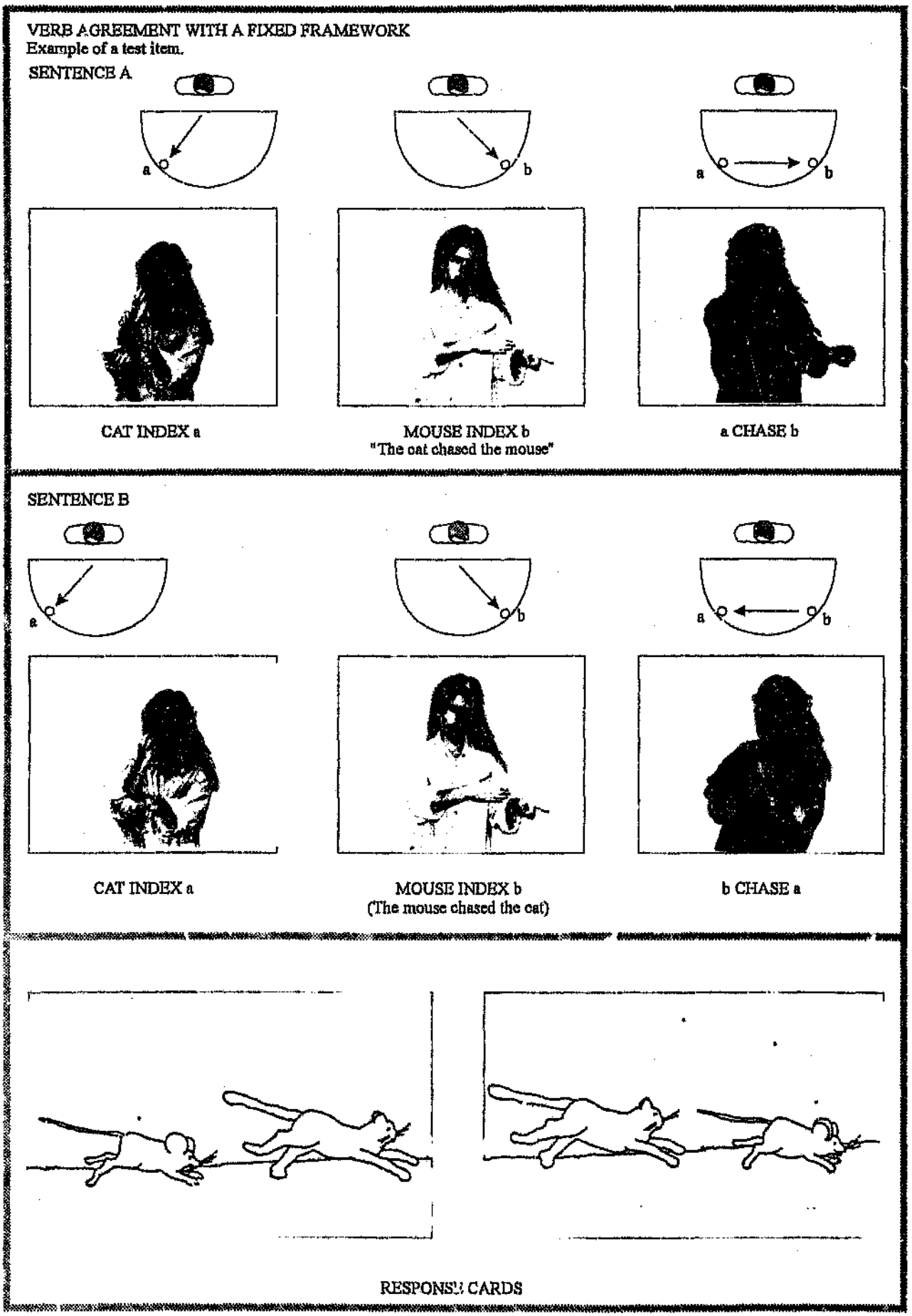


Figure A6: Example of a test item from the Verb Agreement with a Fixed Framework Test

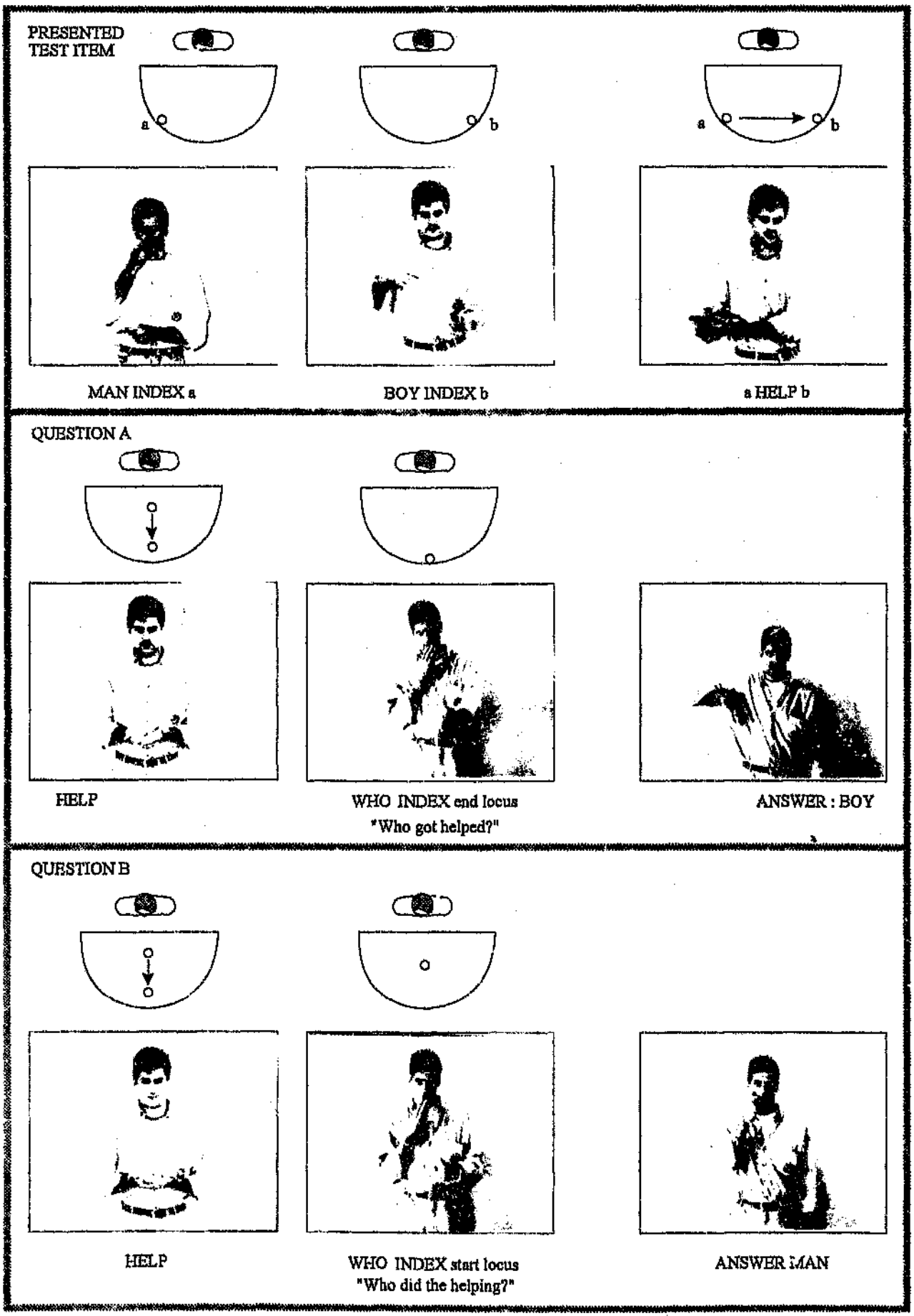


Figure A7: Example of a test item from the Verb Agreement with a Shifting Reference Test

The correct response is "question"

The correct response is "negative", "no" or "not"

Figure A8: Examples of test items from the Name the Grammatical Facial Expression Test

Target expression: "mm" Correct response: A

Figure A9: Example of a test item from the Choose the Correct Facial Expression Test

Correct response: "same"

Correct response: "different"

Figure A10: Example of two test items from the Same/Different Facial Expression Test

APPENDIX B

NARRATIVE DISCOURSE SAMPLES

In this appendix extracts from the narrative productions of one of the control subjects and the three learning disabled deaf subjects are presented. Each extract is presented in the transcribed form followed by an English translation. For the purposes of this appendix, words or explanations which have been added to the translations are in brackets. Hesitations and false starts are represented in transcriptions and translations by ellipses (...).

1 Extract from C2's narrative discourse production

MORNING BOY SLEEP GET-UP $^{(X: boy)}$WALK OPEN-CURTAIN SNOW "ESS". $^{(X: boy)}$PUT-ON CLOTHES SHIRT PANTS $^{(X: boy)}$WALK$^{(I)}$ $^{(X: boy)}$SHOVEL$^{(I)}$ ROLL$^{(I)}$ PUT BALLS ON TOP. MOTHER CALL$^{(X: boy}$ INSIDE$^{(X: house)}$ EAT $^{(X: boy)}$WALK$^{(house)}$ EAT$^{(I)}$ "ESS" $^{(X: boy)}$GO-BACK$^{(I)(X: outside)}$. $^{(X: boy)}$PAT$^{(X: snowman)}$ BALL BODY FACE. $^{(X: boy)}$PUT-ON-FACE$^{(X: snowman)}$ WHAT. $^{(X: boy)}$GOT IDEA $^{(X: boy)}$GO$^{(I)(X: house)}$ FETCH FRUIT APPLE BANANA. $^{(X\ boy)}$PUT-ON$^{(X: snowman)}$ LEFT RIGHT EYE MOUTH WEARING NOT ENOUGH MORE $^{(X: boy)}$WALK$^{(I)(X: house)}$. $^{(X: boy)}$"THIF" FATHER HAT SCARF TAKE TAKE. $^{(X: boy)}$WIND-SCARF$^{(X: snowman)}$ $^{(X: boy)}$PUT-ON-HAT SNOWMAN BODY NICE. $^{(X: boy)}$BACK$^{(X: house)}$ $^{(X: boy)}$LUNCH "ESS" GOOD. $^{(X: boy)}$BACK FINISH-OFF DRESSING$^{(X: snowman)}$ FINISHED. THAT NIGHT $^{(X: boy)}$GO-BACK$^{(I)(X: house)}$ SUPPER NEVER KEEP EYE ON$^{(X: snowman)}$ NEVER. $^{(X: boy)}$"FIS"$^{(X: snowman)}$ $^{(X: boy)}$"ESS" $^{(X: boy)}$EAT FINISH. $^{(X: boy)}$SIT FIRE SIT $^{(X: boy)}$STILL "FIS" "FIS" THEN GO BED $^{(X: boy)}$BRUSH TEETH STILL "FIS". $^{(X: boy)}$GO BED RESTLESS $^{(X: boy)}$GET-OUT-OF-BED OPEN-CURTAIN. NOW $^{(X: snowman)}$MOVE$^{(I)}$ $^{(X: boy)}$"FIS" OPEN DOOR $^{(X: boy)}$WALK$^{(I)}$ $^{(X: boy)}$STOP WALK$^{(I)}$ SNOWMAN ALIVE. $^{(X: boy\ \&\ snowman)}$WALK$^{(I)}$ $^{(X: boy)}$COME IN HOUSE.

English Translation - C1

One morning a boy is sleeping, he gets up and walks to the window, opens the curtains and gets excited when he sees the snow. He puts on his clothes, shirt and pants, then walks outside where he shovels and rolls the snow, and puts balls of snow on top of each other. His mother calls to him to come inside to eat, so he walks back to the house to eat; still feeling excited he goes back outside. He pats the balls to make the body and face. What can he put on the face? He has an idea and goes to fetch fruit, apples and bananas. The boy puts the apples on the face, the right and then the left eye and the banana for the mouth, the snowman does not seem to be wearing enough so the boy walks off for more. The boy steals his father's hat and scarf, he winds the scarf around the snowman's neck and puts the hat on his head, the snowman is looking very nice. The boy goes back to the house for lunch, still feeling very excited and good. Then he goes back to finish off dressing the snowman, then he finishes. That night he goes back to the house for supper and cannot keep his eyes off the snowman at all. He keeps on staring at it rather excited, then he continues to eat and then he finishes eating. The boy sits at the fire, still staring at the snowman, then he goes to brush his teeth still staring. Then he goes to bed but sleeps very restlessy, he gets out of bed and opens the curtains. Now the snowman is moving. The boy stares with disbelief, opens the door and walks out, stops and continues to walk, the snowman is alive. The boy and snowman walk back to the house and the boy tells the snowman to come into the house.

2 Extract from LDD1's narrative discourse production

PEACH $^{(X: boy)}$PUT PUT$^{(X: face)}$ COCKTAIL PUT$^{(X: nose)}$ AHA ONE MORE COAL $^{(X: boy)}$PUT PUT PUT$^{(X: boy chest)}$ PUT PUT PUT$^{(X: snowman chest)}$ NICE "WHEE". $^{(X: boy)}$WALK$^{(I)}$ ... FOR SUPPER $^{(X: boy)}$WALK$^{(I)}$ EAT. NIGHT BOY STAND BY WINDOW STILL $^{(X: snowman)}$STAND $^{(I)}$ "WHEE" DESIGN GOOD. BOY GO SLEEP WALK$^{(X: BED)}$ $^{(X: boy)}$STILL THINK "ALM" AGAIN. $^{(X: boy)}$LOOKS$^{(X: snowman)}$ STILL STAND GOOD $^{(X: boy)}$GO SLEEP. $^{(X: boy)}$AGAIN WHY LOVE PRO.3 ... NICE $^{(X: boy)}$OPEN CURTAINS. $^{(X: boy)}$"YEEOW" SNOWMAN ... HELLO $^{(X: boy)}$STARES$^{(I)}$ "YOW" "FIS" BOY HOW YOU SNOWMAN SO WHAT THIS POSS.1 HOUSE COME COME LET'S SHOW. SNOWMAN FINE WALK$^{(I)(X: boy \& snowman)}$ "HRMM"$^{(X: snowman)}$ IN "LUH-LUH". SNOWMAN L-A-M-P PRO.3 WHAT MEAN $^{(X: boy)}$LIGHT PRO.1 SHOW PRESSES ON OFF ON OFF. SNOWMAN "HMM" ON OFF ON OFF. BOY FIRE FIRE WARM $^{(X: snowman)}$SHIES AWAY EASY PRO.1 MAKE

MELT SHIES AWAY (X: snowman)"HMM" WALK-AROUND(I). THEN BOY PRO.1 SHOW ... SHOW PRO.1 MOTHER FATHER SLEEP SHSH SNOWMAN FINE (X: boy & snowman)SH TIPTOE TIPTOE(I) UPSTAIRS OPEN DOOR.

English Translation - LDD1

A peach is put on the face, a cocktail (carrot) is put on for the nose, aha, one more thing, coal, which he puts on his chest and then the snowman's chest, nice, wonderful. The boy walks to the house ... for supper and eats. That night the boy stands by the window, the snowman is still standing there, a wonderful, great design, good! The boy goes to sleep, can't stop thinking about it and wants very much to check again. He goes to the window and looks out, the snowman is still standing there; satisfied, he goes to sleep. The boy again opens the curtains and looks, why, because he loves it, and it is nice. To his amazement, the snowman says "hello", the boy continues to stare in disbelief and amazement and then the boy says,"How are you?" The snowman says "What's this?". The boy tells the snowman to come in so that he can show him around. The snowman says "fine" and they walk around the house, the snowman seeing very interesting and new things. The snowman asks the boy what the lamp is, to which the boy responds "light, let me show you how it works" and presses the light on and off repeatedly. The snowman finds it fascinating and tests it out himself, pressing it on and off repeatedly. The boy says the fire's warm, yet the snowman reacts by shying away. The snowman exclaims "I could melt easily". Then he shies away from the fire again, he shows interest in the fire and then they walk around again. Then the boy shows ... shows his mother and father sleeping and cautions the snowman to be quiet, to which the snowman agrees and they tip toe upstairs and the boy opens the door.

3 Extract from LDD2's narrative discourse production

THEN (X: boy)RUN TO IN BORROW PRO.3 MOTHER ORANGE FOR NOSE AND ... EYES ANOTHER COAL FIRE COAL PUT BUTTONS(X: snowman chest). LOOK BEAUTIFUL PUT HAT AND ROLL ... ROLL-OVER SNOWMAN (X: boy)GO TO BACK ... SUPPER HOME. KEEP EYES ON SNOWMAN ALL NIGHT GO BED CAN'T SLEEP UNTIL AFTER TWELVE O'CLOCK (X: boy)WENT ... WENT(I). AH SNOWMAN ... WAKE, ALIVE BACK LIFE THEN WALK(I). COME INSIDE INTRODUCE PRO.2 SNOW COME. (X: snowman)LOOK COAL WHAT'S THAT. BOY WANT TO SHOW THROW AT FIRE PLACE. (X: snowman)FRIGHTENED DON'T LIKE THIS FIRE PLACE, OOH. OFF DON'T WORRY, PRO.3.pl.

WALK WENT TO KITCHEN LOOK SEE BOTTLE WHAT IS THINGS STUPID THINGS. (X: boy & snowman)MAKE EVERYTHING WATER SQUEEZE MAKE EVERYTHING MESS (X: boy & snowman)LAUGH.

English translation - LDD2

Then the boy runs in to borrow mother's orange for nose and ... eyes and coal for buttons and puts the buttons on. (The snowman) looked beautiful, (the boy) adds on the hat (and scarf) on the snowman and then goes back home for supper. (The boy) keeps his eyes on the snowman all night, goes to bed, but can't sleep, after twelve o'clock he goes ... outside. The boy shows amazement as the snowman comes to life and walks. (The boy) says "Come inside" and introduces (leads) the snow (snowman) inside. (The snowman) sees the coal and wonders what it is. The boy tries to show him by throwing the coal in/at the fire place. Scared the snowman says "I don't like this fire place". (The boy) turns the fire off and tells the snowman not to worry and then they walk to the kitchen. (The snowman) looks, sees a bottle and says "What are these things?" and "stupid things". They squeeze water and make a mess of everything and laugh.

4. Extract from LDD3's narrative discourse production

(X: boy)COME LET'S WALK-UP(I) SILENT QUIET TO ... FATHER MOTHER ROOM. (X: snowman)SEE (X: boy)OPEN (X: snowman)SEE SEE SEE WHAT IS TEETH FALSE TEETH IN GLASS IN FALSE IN WHAT (PRO.3) . MAN LOOK-DOWN(I) MAN EXPLAIN ABOUT PRO.3 PRO.1 FATHER TEETH GONE THEN PUT TEETH-IN MAN OH PRO.1 SEE. THEN SEE LOOK PHOTO WHO BOY LITTLE PHOTO BOY. THEN (X: boy & snowman)WALK TO ... SEE WHAT CLOTHES (X: boy)TAKE(I) (X: boy)PASS(I) TO SNOWMAN "PUT ON" FUNNY GLASSES ENJOY NICE. THEN FINISH(I) PUT-OFF, PUT-AWAY. THEN (X: boy & snowman)WALK TO WALK ... SEE TORCH FOR ENJOY ... PLAY WITH PRO.1.pl. PRO.1.pl TORCH-ON LOTS BALLOONS BALLOONS. ... OPEN LIGHT OPEN TORCH BRIGHT BALLOONS UP FUN. THEN ... PRO.3.pl. WALK(I) ... TO ... HUNGRY EAT SOMETHING. (X: snowman)DOWN LOOK FRIDGE AH FRIDGE WARM BUT NOT COLD COLD FRIDGE OPPOSITE FRIDGE COLD. THEN ... PRO.3 WALK(I) ... WALK(I) (X: snowman)SEE AGAIN OTHER FRIDGE BIG ... COMFORTABLE

SLEEP[1] IN FRIDGE SLEEP FINISH. PRO.3 TAKE OUT COOK NOT COOK COLD FOOD COLD.

English Translation - LDD3

The boy says to the snowman "Come let's walk up quietly to my father and mother's room". The snowman looks when the boy opens the shirt (opens the door) and the snowman asks "What are the false teeth in the glass?" While the snowman looks down the boy explains about his father's teeth which are gone and then the snowman puts the teeth in and now understands. Then the snowman looks at a photo and is not sure who it is and then realises it is the little boy. Then they wa[illegible] to see the clothes and the boy takes the clothes and passes them to the snowman who puts on funny glasses. They enjoy themselves it is nice. Then they finish by taking off the clothes and glasses and put them away. Then the snowman and boy walk, then they see the torch with which they can enjoy themselves. They play with the torch putting it on and with the balloons. They put on the torch and play with the balloo[illegible] up in the air. Then they walk ... to ... (they) are hungry and want something to eat. The snowman looks down at the fridge, the one fridge is warm, not cold, but the opposite fridge is cold. Then the snowman walks ... and walks to see the other big fridge (freezer), and sleeps comfortably in the fridge (freezer), then they finish that. They take out food which does not need to be cooked.

APPENDIX C

PILOT WORK CONDUCTED ON THE GRAMMATICAL FACIAL EXPRESSION TESTS

The three grammatical facial expression subtests were piloted on a group of six nondisabled deaf subjects. The biographical information pertaining to these subjects is displayed in Table C1 and the scores obtained by the six subjects on all three tests is shown in Table C2. The results from this pilot study indicate that subjects with a profound loss, who rely on sign language as their primary means of communication, and who have no known visual perceptual deficits, present with no difficulties in identifying the target facial expressions. It is believed that the lower scores obtained by Subjects 5 and 6 may be explained by their degree of hearing loss being severe rather than profound, with the result that they rely on sign language as a primary means of communication to a lesser extent than those subjects with a profound hearing loss and hence had more difficulty in identifying facial expressions used for linguistic purposes in sign. The results for the third subtest, Same/Different Facial Expression Discrimination Test, in which all subjects obtained 100%, suggest that the test may lack sophistication and hence does not tap difficulties in discriminating the identity of faces.

Table C1: Case history details pertaining to the subjects of the Grammatical Facial Expression Tests pilot study

	S1	S2	S3	S4	S5	S6
Age	18 years	17 years	17 years	18 years	18 years	18 years
Sex	M	F	F	F	F	F
School	St Vincent's School for the Deaf	St Vincent's School for the Deaf	St Vincent's School for the Deaf	St Vincent's School for the Deaf	St Vincent's School for the Deaf	St Vincent's School for the Deaf
Degree and type of hearing loss	bilateral profound sensori-neural	bilateral profound sensori-neural	bilateral profound sensori-neural	bilateral profound sensori-neural	severe sensori-neural	severe sensori-neural

Table C2: Scores obtained on the pilot study for the three Grammatical Facial Expression Tests

	S1	S2	S3	S4	S5	S6
Name the facial expression (max. poss. score 16)	16 100%	16 100%	16 100%	13 81%	13 81%	12 75%
Choose the correct facial expression (max. poss. score 16)	16 100%	16 100%	16 100%	15 94%	10 63%	11 69%
Same/different facial expression (max. poss. score 12)	12 100%	12 100%	12 100%	12 100%	12 100%	12 100%

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