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The development of a universal Speech Facilitation Program as an extension of the Speech Motor Learning Program and its application in an experimental alternating treatment study

by

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As partial fulfilment of the degree M. Communication Pathology

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November 2000

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Title: **The development of a universal Speech Facilitation Program as an extension of the Speech Motor Learning Program and its application in an experimental alternating treatment study.**

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Summary:
A universal speech facilitation program was developed based on the principles, methods and long-term goals of an existing program, the Speech Motor Learning Program (Van der Merwe, 1985). The development of such a program was indicated because, to date, no systematized intervention program with the aim of general speech facilitation has been attempted to overcome the tremendous challenges of the current rehabilitative scenario in South Africa (shortage of services, untrained staff in the community and multiple language barriers to name a few). The suitability of the SMLP as a starting point for the compilation of a Speech Facilitation Program is illustrated by its clinical success in treating a variety of speech disorders and secondly because it is firmly based on normal speech development and motor learning principles. Based on the SMLP, the SFP was developed and applied to two paired subjects who exhibited general speech and language delay, to determine if the speech facilitation program would facilitate and indeed enhance speech development in the subjects. The clinical application of the SFP was conducted in an alternating treatment design study using speech facilitation and language treatment respectively. During the treatment phase of the study, probe tests, consisting of ten selected aspects of speech and language, were conducted to determine the effect of the two treatment approaches on these aspects.
Three of the aspects showed improvement following treatment with the Speech Facilitation Program. Four aspects showed gradual development throughout the duration of the study, irrespective of the type of treatment and it could possibly be attributed to general development by the subjects as well as regular intervention. Three aspects showed no change during the study.
The obtained results seemed to indicate that the SFP influenced speech development positively and that it could be developed into a valuable clinical tool for the treatment of certain speech disorders.

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Opsomming:

'n Universele Spraakfasilitasie program is ontwikkel gebasseer op die beginsels, metodes en langtermyn doelwitte van 'n huidige program naamlik die *Speech Motor Learning Program* (SMLP) (Van der Merwe, 1985). Die behoefte aan so 'n program is aangedui deur die gebrek aan gesistematiseerde intervensie programme wat algemene spraakfasilitasie ten doel stel te midde van geweldige uitdagings in die huidige Suid-Afrikaanse rehabilitasie konteks (te kort aan dienste, onopgeleide personeel in gemeenskappe en veeltaligheid om slegs enkele uitdagings te noem). Die geskiktheid van die SMLP as beginpunt vir die opstel van 'n Spraakfasilitasie Program (SFP) word geïlustreer deur die kliniese sukses wat met die program ondervind is in die behandeling van 'n verskeidenheid van spraakafwykings en ook omdat dit gegrond is op normale spraakontwikkeling en beginsels van motoriese leer. Die SFP is gevolglik ontwikkel en toegepas op twee geskikte proefpersone met spraak- en taalagterstande om te bepaal of the SFP spraakontwikkeling sal fasiliteer. Die kliniese toepassing van die SFP het geskied in 'n alternerende behandeling ontwerp studie waartydens daar respektiewelik behandeling met die SFP en taalterapie toegepas is. Tydens die behandelingsfase van die studie is steekproewe, bestaande uit tien geselekteerde aspekte van spraak en taal, uitgevoer om te bepaal wat die effek van die twee behandelingsbenaderings op spraakontwikkeling is.

Drie van die aspekte wat het verbeter na die behandeling met die SFP. Vier van die aspekte het geleidelike verbetering getoon, ongeag van die tipe behandeling en dit kan moontlik toegeskryf word aan algemene ontwikkeling deur die proefpersone en die gereelde behandeling wat ontvang is. Drie van die aspekte het geen verandering tydens die studie ondergaan nie. Vanuit die resultate blyk dit wel dat die SFP spraakontwikkeling positief beïnvloed het en daar is 'n beduidende indikasie dat die SFP wel verder ontwikkel kan word in 'n waardevolle kliniese hulpmiddel vir die behandeling van sekere spraakafwykings.

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Acknowledgements

This study was partially supported with research grants from the:

- Human Sciences Research Council
- UP Postgraduate Grant

My sincere appreciation is extended to the following people:

- Prof. Anita Van der Merwe - promoter
- Mrs. Emily Groenwald – co-promoter
- Mrs. Elsie Naudé for her generous assistance with the manuscript
- Mr Herman Tesner for his participation in the intelligibility rating
- Mrs Karin Moorhouse for her assistance in the quality control of experimental data
- The Fouché for their participation in the study

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Chapter 1

Problem statement.

1.1 Introduction

This chapter endeavours to expound the motivation for the aims of the study. The aims are twofold: firstly, the development of a treatment programme that can facilitate and enhance speech development and secondly, the implementation of the program on two subjects in an alternating treatment design.

1.2 Orientation and rationale of the study

The general speech facilitation program (SFP) to be developed in this study is based on the principles, methods and long term goals of an existing program, the Speech Motor Learning Program (SMLP) (Van der Merwe, 1985). The SFP will be utilized in an alternating treatment design for two subjects with delayed speech development.

To date no systematized intervention program with the aim of general speech facilitation has been attempted. The emphasis in intervention rather remains on the acquisition of specific sounds and on linguistic aspects, particularly language use in a functional context. Speech development factors, particularly the motor learning involved in speech development, even in disorders like phonological impairment and stuttering, are neglected. This results in treatment not addressing the underlying processes of speech development and motor learning as considerations of intervention.

An existing treatment program based on normal speech development and motor learning principles that is suitable as a general speech facilitation program is the SMLP. The SMLP is primarily aimed at treating Apraxia of Speech but because it is firmly grounded in speech development and motor learning principles, it has achieved wide success in its application to a variety of speech disorders. The

SMLP's suitability in treating a range of speech disorders qualifies it as a possible starting point from where a generalized, universal adaptation of the program may be able to meet the current rehabilitation demands in Southern Africa.

Rehabilitation in South Africa has undergone marked changes in the last decade and the field of speech and language pathology has had to adapt to and meet the challenges posed by universal and national socio-political changes. Although the shortage of services remains a pressing problem, the services that do exist are now accessible to a much broader section of the population than before. In addition (partly because of the worldwide focus on early intervention) more young children who experience barriers to speech and language development are being identified. These children are candidates for intervention, either rehabilitative treatment or stimulation programs to augment the development of their innate abilities. An urgent need exists for preventative health care and community based intervention. Such projects would involve multi-level participants, from untrained volunteers, through trained community workers, to professionals such as speech-language pathologists involved in private practice, university departments and similar settings. An essential feature of a universal speech facilitation program should, therefore, be accessibility to various professionals as well as caregivers involved on different levels in the field of communication pathology.

In addition to being utilitarian to professionals and various caregivers, the intervention program/process should not be hampered by extreme language specificity so that it remains exclusive to the benefit of a fortunate few. It should be accessible across as many as possible linguistic barriers. The intervention should, however, not be too generalized and superficial as to defeat the facilitative nature of the program.

The SMLP (Van der Merwe, 1985) is based on principles of speech motor learning and is not language specific. It was designed as a treatment program for Developmental Apraxia of Speech (DAS), but has also had clinical value in the treatment of articulation disorders, stuttering, phonological impairment, Apraxia of Speech (AOS), dysarthria and other neurogenic disorders. A possible explanation for the for the wide application of the SMLP (Van der Merwe, 1985) could be that speech production was addressed from a sensorimotor perspective that deals with the planning, programming and execution of speech movements, the motor principles that govern these complex motor acts, motor learning and normal speech acquisition principles. The fact that the SMLP can be successfully applied to a range of disorders suggests that it can also be adapted to be used as a general speech facilitation program. A detailed discussion of the SMLP will be rendered in Chapter 2.

The SMLP's format, stages in treatment, principles and long term goals were used to develop a universal speech facilitation program. The sequence of sounds and the chronological order in which they occur in the SFP are based on the universal sequences observed in normal speech acquisition.

The SFP was then applied in an alternating treatment design with two paired subjects who exhibited general speech and language delay, to determine if the speech facilitation program would facilitate and indeed enhance speech development in the subjects.

1.3 Definition of terms

1.3.1 Speech Facilitation Program (SFP)

The term refers to a program that was developed specifically for this study. It is based on the Speech Motor Learning Program (Van der Merwe, 1985) in terms of its basic principles, format, stages and long-term goals while utilizing the universal developmental sequence of sounds as described in early speech acquisition literature. It is, therefore, a ready-made program with pre-selected target sounds, words and phrases.

1.3.2 Speech Motor Learning Program (SMLP)

A program developed by Van der Merwe (1985) for the treatment of Developmental Apraxia of Speech and other neurogenic disorders. It is based on the principles of motor learning and normal speech acquisition and forms the basis of the SFP of this study. The basic training unit of the SMLP is sound sequences that are selected for each subject is specific and relates to the specific individual phonemic repertoire and his/her sound production skills.

1.3.3 Normal speech development

It is the way phonemes are produced by, and the sequence in which early phonemes emerge in the young child. The syllable structures that are found in the early utterances of children also fall under speech development.

1.3.4 Alternating Treatment design.

A research design that enables the researcher to determine the effect of certain treatments on a particular behaviour when administered in a particular order to subjects.

1.4 Division of Chapters

Chapter 1: A motivation and rationale for the study are provided.

Chapter 2: Theoretical orientation and considerations will be discussed in terms of its implications for the compilation of a speech facilitation program.

Chapter 3:The research methodology for the two phases of the study will be provided namely how the speech facilitation program was researched and compiled and then also how its effectiveness was examined in an alternating treatment study.

Chapter 4:The description and discussion of results of the experimental phase of the study are rendered.

Chapter 5: A summary of the results, their conclusion, evaluation of the research method and recommendations for future research are provided.

A list of references is provided.

1.5 Summary of Chapter 1

This chapter introduced the reader to the rationale of the study. Certain items of terminology were highlighted and the division of the chapters were outlined.

Chapter 2

Theoretical considerations in the compilation of a speech facilitation programme – The SMLP, early speech acquisition and their respective contributions to the speech facilitation program.

2.1 Introduction

There is a need for a non-language-specific, easy to follow universal speech facilitation program that will induce and enhance speech development. Existing remediation programs have not addressed speech development from this perspective. The aim of the study is to develop a Speech Facilitation program specifically for the facilitation and enhancement of speech development.

The theoretical considerations that formed the basis of the development of a speech facilitation program will be discussed. The SMLP (Van der Merwe, 1985) will be described in detail within a context of motor learning. The SMLP was used as basis in developing the SFP. The influence of normal speech development (the early sounds and how they combine into babbling and first words) on the selection and sequencing of the material will be discussed.

2.2 The Speech Motor Learning Program (SMLP) (Van der Merwe, 1985) as a basis for the development of a universal SFP.

2.2.1 Introduction

The SMLP was developed in 1985 by Anita van der Merwe. It was originally aimed at the assessment and remediation of Developmental Apraxia of Speech (DAS). Since then, the SMLP has been used successfully in therapy for DAS as well as for other communicative disorders. This section will deal with the nature, purpose, principles and format of the SMLP and why it is so well suited for addressing various communication pathologies. The application of the SMLP as a basis for a universal SFP, and the adaptations necessary for the SFP will also be indicated.

2.2.2 An historical overview of the SMLP (Van der Merwe, 1985)

Drawing on many years of clinical experience, Van der Merwe (1976) published an article on the treatment of DAS. Included in the article was a concise description of the treatment of the disorder. A more comprehensive description of the differential diagnosis of DAS, articulation and minimal dysarthria, as well as treatment of DAS, were published in a second article (Van der Merwe, 1980). This treatment approach was adopted by staff and students of the University of Pretoria Speech, Voice, and Hearing Clinic for clients with DAS. In 1982 a questionnaire on the utility of the approach was distributed to 90 institutions and private practices. From the obtained data from outside the University clinic, as well as the data collected from the application of the program in the clinic itself, it was revealed that the treatment approach was being used widely and with success, both for the treatment of DAS and for many other speech impairments such as phonological disorders, stuttering, articulation and neurogenic disorders (AOS, dysarthria) (Van der Merwe, 1985).

Furthermore, the treatment approach was successfully implemented with clients who speak Afrikaans, English, Sepedi and German. Although phonological process disorders, stuttering, articulation and AOS are generally categorised as speech disorders, each of these disorders are hypothesised to be a result of an impairment on different levels of the speech production process (Van der Merwe, 1997). This method of treatment, however, has had clinical success in the treatment of these different disorders. There seems to be a common denominator among these disorders, namely a problem in the production of speech and the SMLP taps into this "denominator" to improve speech production in all of these cases, irrespective of the language background. The reason for the successful application to all of these disorders is probably twofold. In the first place, speech production is approached as a motor skill. Secondly, the treatment program also provides the opportunity for sensorimotor integration and for phonological development.

The principles of the SMLP are of interest because they describe the theoretical orientation of the SMLP towards speech production and impairment, and will explain why the SMLP has had such wide success and is suitable for the development of a SFP. The principles as well as the structure of the SMLP will therefore be discussed in detail.

2.2.3 The principles of the SMLP (Van der Merwe, 1985)

The principles of the SMLP are based on principles of motor learning as well as on the theoretical framework for speech sensorimotor control as postulated by Van der Merwe (1997). Sensorimotor integration and phonological development in particular , as described by Van der Merwe (1997) in her Four Level Framework, are addressed in the principles of the SMLP. A detail description of the Four Level Framework (Van der Merwe, 1997) is beyond the scope of this paper and will therefore not be presented explicitly as it relates to the SMLP (Van der Merwe, 1985).

Each SMLP principle will be discussed with a short motivation from a motor learning perspective while the emphasis on sensorimotor integration, speech motor planning and phonological development of the Four Level Framework (Van der Merwe, 1997) is implied. Some of the principles are closely linked, but will be discussed separately. The reader should, however, keep in mind that all the principles interrelate intricately in the SMLP.

Motor learning is defined by Schmidt (1988) as processes associated with practice and/ or experience which results in relatively permanent changes in response capability. Singer (1980) describes motor learning as the acquisition as well as the performance of certain behaviours that manifest as movement. This leads to the development of a motor skill. Singer (1980) continues by stating that motor skills are refined from basic movement patterns that, in turn, are dependent on the degree of presence of relevant abilities. The acquisition of these motor skills and movement patterns occur through learning.

With the SMLP, the learning is concerned with the basic movement patterns and motor skills of speech production. Any impairment may affect all aspects of motor speech namely respiration, phonation, articulation, prosody and these impairments should be addressed through the treatment of the motor system (Darley, Aronson & Brown, 1975).

Singer (1980) states that certain factors underlie gross and fine motor skills namely strength, precision and timing. When considering such a complex motor skill as speech production, Darley, Aronson & Brown (1975) identify the following factors that are required for speech production namely precision of timing, strength of contraction, the range, speed, accuracy and direction of movement. These factors should be addressed in any treatment program concerned with motor speech. The SMLP addresses these dimensions of speech movements through the implementation of motor learning principles in the treatment of speech impairments.

Sensorimotor integration, specifically oral-tactile, proprioceptive and auditory feedback of the production is facilitated through the SMLP. Phonological development is also stimulated in the SMLP through the immediate transition from nonsense structures to meaningful utterances.

Principle 1

Intensive drill of nonsense syllables (CVCV units), as well as other nonsense structures form the basis of the SMLP (Van der Merwe, 1985). Van der Merwe motivates the use of nonsense syllables firstly by stating that movement patterns are thereby imprinted in the brain without the interference of previously formed erroneous habits. She continues by saying that the use of nonsense syllables is a cross-sectional method to improve motor function as a cerebral controlled system as opposed to an "isolated entity" approach of single sounds and specific words. Speech as a motor action without linguistic connotation is improved through the medium provided by the nonsense syllables and transfer of corrected motor patterns to meaningful speech is automatically facilitated. Hall, Jordan & Robin (1993) share this opinion when they state that motor approaches to DAS therapy should stress movement sequences and the development of motor memory for those movement patterns. Schmidt (1988) states that it is easier to learn a motor skill correctly from the initial stage than to undo past mistakes. The use of CVCV nonsense syllables enable the client to learn the movement patterns under controlled conditions correctly.

CV and CVCV units are used in the initial stages of the program. Data from the literature indicates the suitability of the CV and CVCV units as initial facilitating stimuli. Kent & Bauer (1985) found CV and CVCV structures to be the first to emerge in the infant and postulate that these units constitute the basis of all other structure variations such as CVC, CVCVC and even CVCVCVC. Stark (1996) also found the CVCV structures valuable for learning more complex forms.

Principle 2

The core motor plan of each sound (its spatial and temporal requirements) is learned (Van der Merwe, 1985, 1997). The core motor plan is then adapted to the phonetic context in which the sound occurs.

The motor plan is defined by Van der Merwe (1997) as the gradual change of phonemes to a motor system code. Motor planning, therefore, specifies the motor goals and provides the specification of movements (place and manner of articulation) for sound production via the core motor plan for each sound. The motor goal of a phoneme is planned, sequenced and fed forward to the articulator. Following the movement, extensive feedback is relayed to the Central Nervous System to determine the nature of the movement namely the goal, smoothness and level of effort of the movement. It is hypothesised that neural and musculo-sceletal development are continuous through the first ten years, with early emphasis on achieving the spatial aspects of motor-acoustic goals, and later emphasis on optimising speaking rate (Netsell, 1981). Smith & Goffman (1998) state, however, that temporal aspects of movements mature before spatial aspects. They continue by stating that distinctive open-close patterns of bilabial movements are produced by children at the age of 4 and that these patterns meet variable acoustic as well as phonetic goals with the help of the motor plan.

In the SMLP the movement pattern or motor plan of a speech sound is placed in different sound environments and with different degrees of variation between consecutive sounds (see discussion of variation levels Principle 5). Plasticity is thereby created in the plan to ensure that adaptation of the sound to its preceding and following sounds can occur (Borden, Harris & Raphael, 1994). The nonsense syllables and sequences are developed in such a manner as to allow for sound placement in different sound environments. Co-articulation potential (Van der Merwe, 1997) is therefore created and the motor plan is allowed to make the necessary adjustments in the pre-, during- and following movement stages as described by Schmidt (1988).

Adult-like use of co-articulation and motor control, however, are not achieved around the end of the first decade of life (Kent, 1976) by which age children have developed speech motor skill that enables co-articulation and adaptation (Borden, Harris & Raphael, 1994) to occur during speech production.

Principle 3

Drill work (repetitive production of units) is an essential component of the SMLP. Rosenbek & Lapointe (1985) describe drill as the systematic practising of specially selected and ordered exercises. Hall, Jordan & Robin (1993) describe many repetitions elicited in drill-oriented sessions in their discussion of DAS treatment procedures. Macaluso- Haynes (1978:247) motivate the use of drill in treatment as a tool to increase volitional control over movement and what they describe as ..." the ingraining and habituation of accurate motor planning for speech."

Numerous repetitions are consistent with theories in motor learning. Schmidt (1988) emphasises this point by stating that drill has always been the fundamental means of training and teaching a motor skill.

The above premise was examined by Corcos et al. (1993) in a study of myoelectric and mechanical variables of repeated elbow flexion movements. According to Itoh & Sasanuma (1984) and Brooks (1986) learning within a motor context occurs when motor behaviour improves with repetition of the behaviour, when improvements are retained over a long time interval even when the behaviour is not performed and when the behaviour becomes less variable. In their study, improvement in performance was defined as peak movement velocity, decreased peak velocity variability, increased acceleration and deceleration, a proportionally greater increase in peak deceleration that peak acceleration and greater consistency in terminal location. All subjects improved in consistency with which they made movements while they were decreasing movement time and this suggests that decreased variability can be achieved despite increases in movement speed. Not all subjects demonstrated enhanced performance to the same extent but the findings suggested that " extended practice can give at least some subjects flexibility in modifying the motor programs that underlie movement" (Corcos et al., 1993: 499). Improvement and increased control in speech production will result in more consistency in production with less variability.

In the SMLP, productions follow a transition of voluntary production to automatic production with drill work implemented as a facilitating technique. Drill work is intensive and systematic to ensure the learning or relearning of skilled speech movements in a formal structured environment. According to Wertz, LaPointe & Rosenbek (1984), the purpose of drill work in an acquired speech disorder is to retrain pre-programmed movement sequences that make normal speech automatic and effortless. The ideal, according to Van der Merwe (1985), is that repetition should be continued until a conscious voluntary effort is required for an erroneous production of a sequence.

Principle 4

During the drill work, a consistency demand for the correct production of a target sound is implemented. Sound distortion due to variation in manner or place production is not allowed in the SMLP (Van der Merwe,1985). Rosenbaum (1991) indicates that responses are frequently not allowed to vary in motor learning. This reduction in degrees of freedom promotes consistency of responses by highlighting what must be attended to and controlled.

This consistency demand is, furthermore, an essential component of self learning (Wertz, LaPointe & Rosenbek, 1984). From as early a stage as possible, the client should be urged to monitor his own speech. Hall, Jordan and Robin (1993) deem self monitoring critical in the remediation process. Singer (1980) recommends the transfer of control from stimuli external to the client to stimuli internal to the client as soon as possible in the remediation process. The client 's awareness of feedback clues and self-correction are, therefore, essential to the remediation process.

Principle 5

Phonetic complexity and the degree of consecutive variation in motor action are systematically and gradually increased through the selected sound combinations on the five different variation levels in the SMLP. Each level consists of sequences of nonsense syllables. On each level, the + following a consonant or a vowel indicates that that sound will vary. The variation levels of the SMLP are:

Variation level 1: Consonant (C) 1, Vowel (V) 1, Consonant (C) 1, Vowel +
Variation level 2: C1,V1, C2, V+
Variation Level 3: C1, V1, C+, V1
Variation Level 4: C1, V+, C2, V1
Variation Level 5: C1, V+, C+, V+

Each sound has to occur in each position (1 and 2) and in combination with all or most of the other sounds of the language during the course of treatment. In this way plasticity and adaptation of the core motor plan to different phonetic contexts are facilitated (Van der Merwe, 1997).

Sequences of nonsense units, which contain 5-6 units per sequence, are developed for each variation level. All the target sounds are to be included in the sequences developed for each variation level. By gradually increasing the amount of variation within a sequence of nonsense units on the different variation levels, the demands placed on the speech motor planning system are increased. The complexity of the utterance that has to be planned by the brain increases. Hall, Jordan and Robin (1993) state that remediation of a motor skill should progress systematically through hierarchies of task difficulty. This approach corresponds to the learning principle of commencing with the most simple task and slowly increasing task difficulty until the most complex task is accomplished. In the SMLP, the sounds are graded in terms of ease of production for the client and the first stage starts with the easiest to produce target sounds. There should be progression from single movements, to simple movement sequences to complex movement sequences in a controlled fashion in motor learning (Schmidt, 1988). The SMLP accomplishes this goal through the implementation of Principle 5. The aim is to expand the stimulus range to ensure that the client has the opportunity to gain articulator and speech movement control over a larger number of phonemes and phoneme sequences. The careful sequencing of material, to ensure these incremental increases in task difficulty, is integral in motor learning in general and in the SMLP in particular.

Principle 6

Once the stimulus range is expanded to include a repertoire of sounds, minimal consecutive variation, such as contrasting voiced and voiceless sounds, is gradually introduced for sound production that remains problematic to the client. Principle 6 is, therefore, implemented with regard to the error sounds that were previously not contrasted within one sequence of sounds. This variation then zooms in on the speech motor action that remains problematic to the client.

Principle 7

Treatment is conducted on a direct level and endeavours to develop an awareness of feedback cues. Self correction is facilitated and encouraged. Duffy (1993) states that immediate, accurate and frequent feedback facilitates performance when a skill is being acquired and is essential to motor learning. Patients should be urged to monitor their speech. Auditory-motor association takes place from an early stage to compare the client's productions with those of the facilitator through visual, aural and tactile stimulation. Wilbur Schramm (1964) mentions that one of the characteristics of a program learning situation is the reinforcement of the response by immediate knowledge of results, particularly in the early stages of learning a skill. Magill (1980) adds that feedback of results should be precise enough to allow the learner to benefit from it.

Principle 8

The utterance length is systematically increased. Each unit within a sequence is individually learned and then the sequence of units is produced. This increase in the number of units develops the brain's strategy for consecutive planning of longer sequences of motor plans and placing them under automatic control (Van der Merwe, 1985, 1997).

Principle 9

Motor memory must be developed for all nonsense units, core vocabulary, phrases or sentences through the use of imitation directly after the facilitator's stimulus and then self-initiated utterances after increasing time delays. The amount of time between the facilitator's stimulus and the client's production should progressively be lengthened. The goal is self-initiated productions to ensure that the core vocabulary may be used independently. Yoss & Darley (1974) state that self initiated attempts should be introduced as soon as possible within the remedial framework because the ultimate goal is carry-over of motor skills into spontaneous speech. According to Yoss & Darley (1974: 364)...."memory for articulation behaviours consists of an internalised and assimilated system based on tactile-kinesthetic-proprioceptive information which explicitly relates heard sound with speech motor patterns":

Principle 10

Self-initiated production of nonsense units, sequences, words and phrases, instead of mere imitation, must be facilitated. Van der Merwe (1985) suggests the use of reading, naming and questions for the elicitation of utterances. In this manner, speech production is developed within a voluntary production context. The length of self initiations after a stimulus should be increased at an early stage. The client is, therefore, required to recall information from his own sensori-motor memory and to execute motor planning according to the assembled information.

Principle 11

The rate of production must be increased to attain a normal speech rate. The increase in speech rate places more demands on the speech production ability (Van der Merwe, 1985; 1997). A consistency demand remains the priority due to its impact on intelligibility. Duffy (1993) suggests that speech rate should only be increased when acceptable intelligibility has been achieved. The motor learning literature describes the speed versus accuracy trade-off that is present in most motor learning situations. It was first described by Fitts (1954) and Fitts' law implies an inverse relationship between the difficulty of a movement and the speed with which it can be performed. The trade-off between speed and accuracy is explained by stating that this trade-off occurs so that the rate of information processing is held constant. In other words, when a movement increases in complexity, more information has to be processed in order to generate a movement that will arrive at the target. It implies that an increase in complexity lengthens the production time. The aim of the SMLP is to increase rate of production of utterances of increasing complexity.

Principle 12

The visual modality must be incorporated through the graphic representation of sounds. Van der Merwe (1985) states that the aim is to increase the client's awareness of the differences between sounds, and the awareness of which sounds is being learned at the current stage. A visual representation of the phonological unit is beneficial to the older child for phonological development and reading to create an awareness of the selection and combinations of sounds.

Principle 13

The use of auditory, visual and tactile stimulation is encouraged. Visual input from the facilitator and mirror work are important and should gradually be decreased as the client progresses. Hall, Jordan & Robin (1993) agree with the maximal incorporation of multiple modalities. Sensorimotor integration of the speaker is facilitated when multiple modalities are used because the client is then aware of the proprioceptive, auditory and visual information that his speech attempt has made available to him (Van der Merwe ,1997).

Auditory-motor association of own productions should be facilitated according to Van der Merwe (1985). It is unnecessary to train auditory discrimination. Duffy (1993) found that the child with DAS is often more than aware of the errors present in his own productions. The facilitator's auditory example is, therefore, of importance. Duffy (1993) states that the auditory example has a dual role in that it demonstrates correct articulatory production as well as the desired prosodic pattern.

Principle 14

Productions can be facilitated through the systematic use of rhythm and motor action. Van der Merwe (1985) recommends a slow rhythm that is gradually increased to normal speech rate. Rhythm, intonation and stress facilitate the motor sequencing needed for speech production (Duffy, 1993).

Principle 15.

The selection of target sounds in the SMLP is based on motor considerations. Sounds are analysed through their specific distinctive characteristics and correlated with the client's production ability. Those sounds with the greatest ease of production are targeted initially. The more difficult sounds are taught at later stages. Three to four target sounds are selected in the first stages to eliminate over -generalisation of one sound and to facilitate variation in production. The first groups of selected consonants should vary as much as possible phonetically to eliminate confusion on a motor level.

Principle 16

The pace of progress should be adapted to the client's ability. Treatment starts with the sounds with the most ease of production by the client and then progresses according to a set pattern. An achievement score of eight out of ten is the prerequisite for progress to the next level.

Principle 17

Intonation and stress should not be over -emphasised in the initial stages to ensure that attention is focused on movement control. Hall, Jordan and Robin (1993) state that prosodic features of speech should be addressed in the remedial process. The SMLP addresses the prosodic features of speech as a main aim in later long-term stages of the SMLP.

Principle 18

Transfer of motor skills from nonsense structures to meaningful speech occurs through the development of a core vocabulary. Initially the core vocabulary consists of words, but is increased to phrases and sentences as soon as possible in the SMLP. The length and structure of the core vocabulary and phrases are prescribed by the target sounds and syllable structures that is addressed at a particular stage of the SMLP. The words and phrases are developed from the various sound combinations of the target sounds in the target syllable structures of the particular stage. This ensures that the core vocabulary is within the production range and abilities of the client. The improvement of expressive language skill in the traditional, formal sense should temporarily be halted until intelligible speech has been elicited.

Principle 19

General rhythmic body actions may be used as a facilitating technique.

2.2.4 The structure of the SMLP (Van der Merwe, 1985)

There are 10 long-term stages in the SMLP. The method to be used in the SMLP are documented at each Stage through certain steps that are to be followed. At each of the ten stages, the five levels of variation are applied. The steps (method) of the SMLP are to be followed at each of the levels of variation as indicated.

An assessment protocol and progress report schedule are also included in the SMLP, with detailed instructions regarding procedures. Through the proper use of the assessment protocol, the client's target sounds and core vocabulary can be developed and through the progress reports, the client's speech production ability can be monitored and tracked over time.

The structure of the SMLP is displayed in Table 2.1.

Table 2.1 The Structure of the Speech Motor Learning Program (Van der Merwe, 1985).

TREATMENT PROGRESS (THE STAGES OF THE SMLP)	METHOD (STEPS TO BE FOLLOWED)	COMMUNICATION SKILLS THAT ARE TARGETED TO DEVELOP AND INCREASE
STAGE 1 Voluntary production of vowels and consonants in isolation and in CV and VC units	Facilitate voluntary actions, production and auditory-motor association	Phonetic ability Phonological ability
STAGE 2 Production of CVCV units on different levels of variation	• Elicit/ obtain accurate production • Extend motor memory • Increase rate of production • Learn core vocabulary • Place in semantic context • Produce in phrase or sentence	Phonetic ability Phonological ability Semantic ability Syntactic ability
STAGE 3 Expansion of consonant repertoire and production of CVCV units on different levels of variation	• Elicit / obtain accurate production • Extend motor memory • Increase rate of production • Learn core vocabulary • Place in semantic context • Produce in phrase or sentence	Phonetic ability Phonological ability Semantic ability Syntactic ability
STAGE 4 Expansion of vowel repertoire and production of CVCV units on different levels of variation	• Elicit / obtain accurate production • Extend motor memory • Increase rate of production • Learn core vocabulary • Place in semantic context • Produce in phrase or sentence	Phonetic ability Phonological ability Semantic ability Syntactic ability
STAGE 5 Production of CVC units with systematic variation of the units	• Elicit / obtain accurate production • Extend motor memory • Increase rate of production • Learn core vocabulary • Place in semantic context • Produce in phrase or sentence	Phonetic ability Phonological ability Semantic ability Syntactic ability
STAGE 6 Production of CVCV and CVC units with minimal phonetic variation and systematic variation of units	• Elicit / obtain accurate production • Extend motor memory • Increase rate of production • Learn core vocabulary • Place in semantic context	Phonetic ability Phonological ability Semantic ability Syntactic ability

	• Produce in phrase or sentence	
STAGE 7 Production of longer and complex nonsense units and core vocabulary Language therapy	• Elicit / obtain accurate production • Extend motor memory • Increase rate of production • Learn core vocabulary • Place in semantic context • Produce in phrase or sentence	Phonetic ability Phonological ability Semantic ability Syntactic ability
STAGE 8 Production of consonant clusters in nonsense syllables on different levels of variation	• Elicit / obtain accurate production • Extend motor memory • Increase rate of production • Learn core vocabulary • Place in semantic context • Produce in phrase or sentence	Phonetic ability Phonological ability Semantic ability Syntactic ability
STAGE 9 Production of problem sounds in CVCV units on different levels of variation and in CVC units and more complex units with systematic variation	• Elicit / obtain accurate production • Extend motor memory • Increase rate of production • Learn core vocabulary • Produce in phrase or sentence	Phonetic ability Phonological ability Semantic ability Syntactic ability
STAGE 10 Improvement of prosodic features in speech	Improvement of pitch, accent, stress and duration control in nonsense units, words and various sentence types Incorporate with language ability	Aspects in communication related to prosody.

2.2.5. The purpose of the SMLP (Van der Merwe, 1985).

The purpose of the SMLP is to facilitate the learning or relearning of motor planning, programming and execution skills in order to facilitate speech production. It aims to train or retrain speech production processes through the implementation of motor learning principles and also through addressing the sensory-motor aspects of speech and to integrate these abilities into a language system. It is conceivable that this fundamental approach is the reason for the success achieved with the SMLP in various speech disorders as will be discussed briefly in the following section.

2.2.6 The applications of the SMLP (Van der Merwe, 1985)

The SMLP has been utilised in the case of various speech disorders in experimental and clinical settings. Neurogenic disorders that have been treated include DAS, AOS and dysarthria. The program had been successful in the treatment of developmental phonological disorders, stuttering and articulation disorders. It has been utilised in the hearing impaired population to facilitate speech. In any disorder where the use of drill work and the systematised grading of a client's speech repertoire are indicated, as is the case in the disorders mentioned above, the SMLP has been successful. In order to address speech acquisition and production on a universal basis across languages, a few adjustments will, however, have to be made.

2.2.7 Requirements for the universal application of the SMLP (Van der Merwe, 1985)

The first requirement for the universalisation of the SMLP into a general speech facilitation program is the standardisation of the sound repertoire used in the SMLP. One important reason for the high success rate of the SMLP could possibly be the fact that each individual client's sound production profile is utilised in the compilation of the SMLP's Stages. In the general speech facilitation program, speech acquisition data from the literature is used and applied to the stages of the SMLP to develop a program according to the sequence in which sounds develop in all languages, i.e. universally.

Now, the starting point is not a particular client's sounds but the first sounds occurring in languages all over the world. The literature on universals in speech acquisition is, therefore, clearly of importance in the selection of sounds of the Speech Facilitation Program and will be discussed in the following section.

2.3 Normal Speech development

2.3.1 Introduction

This section will address the aspects and stages of speech development as they relate to the selection of sounds for the Speech Facilitation Program. An overview of early sounds and sound structures will be given. The babbling period of the infant will be emphasized because of the speech-like nature of babbling utterances. The implications of the various aspects of speech acquisition for the development of a speech facilitation program based on the selection of sounds and sound structures occurring universally, will be discussed. (The term "universal" will be used to imply "occurring in most languages".)

2.3.2 Aspects to consider in speech development

Most of the discussion on early speech acquisition, particularly babbling, centres around the way sounds form a message. Disorders in speech acquisition are then related to the effect on the message (Davis & MacNeilage, 1995; Smith & Goffman, 1998). Researchers and clinicians alike consider the commencement of multi-syllabic babbling as a landmark for communication development (Chapman, 1991). This emphasis on the message component of the babbling utterance is justified by the very strong indication that the way the emerging sounds are organized in a babbling routine relates to the manner in which these sounds are organized in early words (Davis & MacNeilage, 1995). For instance, in both the sounds preferred by the infant and in the sequence of the sounds in the babbling utterance, there are similarities between babbling and early words (Davis and MacNeilage ,1995). Oller et al. (1975) , Stark (1980) and Vihman et al. (1985) found similarities in syllable shape in the pre-speech and early speech behaviours. Furthermore, similarities in deletion and substitution patterns (Oller et al. 1975) and type and frequency of produced consonants (Vihman et al., 1985) were discovered. These similarities indicate that babbling is the crucial step in understanding early speech production ability.

Traditionally, babbling was divided into specific stages. The onset stage was described as reduplicated (CV syllable sequences where the consonants were identical) and less complex babbling, followed by a more advanced stage of development namely variegated babbling (babbling utterances are varied across syllables). Recently, however, researchers like Mitchell and Kent (1990) and Smith and Goffman (1998) have questioned the stage-based description of multi-syllabic babbling. Mitchell and Kent (1990) report that the infants in their study, observed from the age of 7 months to 11 months, produced both reduplicated and variegated babbling utterances from the onset of the study and not in chronologically differentiated stages as traditionally suggested. They concluded that the stage-based model needs to be reconsidered, and suggests a model that considers speech motor skill and the acquisition of motor skill as an additional parameter when describing multi-syllabic babbling as a component in the development of early speech.

The acquisition of motor skill and the motor control necessary for speech output have received relatively little attention in the developmental literature. In cases where motor skill has been addressed, Smith & Goffman (1998) question the validity of the data as the data was taken form studies that examined babbling primarily from a linguistic and phonetic perspective. In other words, the study's focus was on the way in which the sounds form a message in early communication. The influence of motor skill and its contribution to disordered early communication and speech receive little emphasis.

If babbling patterns, at least in the early stages, tend to be similar across languages with regard to the preferred sounds, it may be argued that auditory experience, which may vary across languages, is not the main reason for the uniform patterns that are observed in early babbling. Despite the fact that the role of motor control seems to be regarded as of secondary importance in the literature, the development of motor ability might be the main shaping factor in the patterns of early babbling (Davis & MacNeilage, 1995).

A similar sentiment is expressed by Kent (1982) when he states that more attention should be given to the motor aspects of speech development which will bring to the surface questions about the structural and neuromuscular capability of the developing human infant and child. According to Kent (1982), the ease of production and the ability to produce certain sounds or sequences of sounds at a particular time are much neglected harbingers of speech production. Most authors focus exclusively on the influence of intentional communication, in other words how the sounds can be used to form a message, or the auditory environment.

Thus far, limited information is available on speech production as a motor skill. A few studies documented children's speech motor timing (Nittrauer, 1993) and speech production rate (Sharkey & Folkins, 1985; Smith, 1978; Smith, Goffman & Stark, 1995) in the first decade of life. Kent (1976) described the development of speech motor skill as a process that continues throughout the early years. Adult-like use of speech acoustics and motor control is not achieved until around the end of the first decade (Kent, 1976). He postulates that at the age of approximately ten years children have developed speech motor plans with the full flexibility of adult motor skill that makes it possible for co-articulation and adaptation (Borden, Harris & Raphael, 1994) to occur during speech production. The acquisition of speech production as a motor skill stretches over a long period and is a continuous, but non-linear process. Sensitive periods of non-linearity occur when certain neural, musculo-sceletal, environmental and cognitive changes combine in the individual organism (Netsell, 1986).

Some acoustic studies describing the speech motor timing characteristics in children's speech indicate a general trend towards longer and more variable segmental, syllable and phrase durations in the first decade. Nitrauer (1993) states that the children produced gestures of the vocal tract that are similar in shape to those of adults, but that the movements produced by children are often slower than those produced by adults and show greater temporal variability.

Sharkey & Folkins (1985) found that children were more variable on the kinematic measures of timing, amplitude and speed of movement. Increased speech production rate and decreased variability therefore constitute a general developmental trend reflecting the improvement that occurs with neuromotor development (Sharkey & Folkins ,1985; Smith,1978;1994 & Smith, Goffman & Stark, 1995).

Netsell (1981) hypothesized that neural and musculo-sceletal development are continuous through the first ten years, with early emphasis on achieving the spatial aspects of the motor-acoustic goals, and later emphasis on optimizing speaking rate. Smith & Goffman (1998) state, however, that temporal aspects of movements mature before spatial aspects. If and when spatial aspects of movements do mature, the movements are of the same amplitude as those of adults, but children's movements show lower velocities. According to these researchers children do have less stability in generating patterned speech motor output, but in spite of the lack of stability children aged 4 years already produce distinctive open-close patterns of bilabial movements to meet variable acoustic/phonetic goals.

The studies discussed above did not depict the very early speech and motor development in the same manner in which early speech and utterances are depicted in studies that have a more linguistic perspective. The similarities between the different motor systems are merely touched upon. Kent and Murray (1982), however, stated that early articulatory movements may bear important similarities to early movements of the limbs, fingers and head.

Five years later Netsell (1986) documented particular periods of change in motor control in general and speech motor control in particular, where he relates development in these areas to changes in the maturation of the nervous system. His overview of the stages of development in speech motor control in the first year of life is summarized below.

2.3.3 Different stages of speech development from a motor perspective

2.3.3.1 *The Neonate (0-3 months)*

The following motor acts may be observed at this stage:

- The most notable motor act from the listener's perspective is crying.
- Infant vocalizations in non-distress modes have respiratory and laryngeal controls similar to those used for speech, as acoustic-physiologic studies by Langlois & Baken (1976) indicate.

- With regard to the upper airway movements, there seems to be no indication that the velo-pharynx is opening and closing alternatively as for speech. The tongue and the jaw move as a single unit to effect velar-like stops or apicals, while lip and jaw independence seldom is seen for front-of-the-mouth speech movements (Netsell, 1986).
- All sound productions indicate a rather simple function of the larynx (Netsell, 1986).

These developments in speech motor skill represent the basis from where more sophisticated motor skill develop. When motor skill development is added to a description of the infant's early communication, the vocalizations occurring in the early child/caregiver situation is not only addressed from the context of intentional communication, but an anatomic-physiologic component is added. Therefore, any breakdown in the early communication processes may also be accounted for, or at least partly accounted for, on anatomical or physiological grounds.

2.3.3.2 The babbler (3-12 months)

" The three to twelve month period may be the single most sensitive postnatal period with respect to the eventual acquisition of normal speech motor control " (Netsell, 1986:14). Noteworthy events in neural maturation are the following:

- Myelination of the pyramidal tracts (cortico-spinal and cortico-bulbar), the post-thalamic somatosensory pathway as well as the somatosensory auditory projections.
- The hardwiring of the middle cerebellar peduncle is formed in this period, and the input-output at this level of the cerebellum is regarded as vital in cerebellar speech motor control (Netsell, 1986).

The influence of neural maturation on the development of speech motor control seems to entail the following:

- In beginning to vocalize while sitting up or semi-reclining, the 3 month old infant spontaneously assumes adult-like use of ribcage and abdominal movements (Hixon & Hardy, 1964).
- Adult-like respiratory patterns for speech are formed shortly after the child assumes the vertical alignments of the head, neck and torso.
- The immature swallowing pattern of the infant is developing into a more mature swallow with tongue retraction and more independence of lip and jaw movement.
- The development of speech motor skill and the emergence of babbling in this stage can be identified by the two to four syllables that appear in a single expiration with shapes like C (consonant) V (vowel), VC and VCV. In terms of motor complexity, this requires a constricted oral tract to open (CV), an open oral tract to constrict (VC), an open oral tract to close and open again (VCV) (Netsell, 1986).
- The voiced / voiceless contrast is routinely established by 6 months, suggesting that the adductor-abductor muscles of the larynx have achieved the beginnings of a reciprocal action. The nasal-nonnasal contrast m/b, n/d signals that gross contractions of the palatal levator muscle are starting to take place (Netsell, 1986).
- Consonant productions indicate jaw independence from lower lip and tongue movements at three to nine months.
- A full range of vowels develop in this period.

These changes in motor control and speech motor control demonstrate the psychological and anatomical capabilities of the infant / child and contribute together with the child's linguistic environment, to the emergence of a particular speech sound in the infant / child's repertoire. The status of motor control and developing motor skill may influence the emergence of a particular sound at a particular time . The acquisition of vowel and consonant sounds in this period has , therefore, been documented quite extensively. Davis & MacNeilage (1995) confirm that there is a continuity from the speech-like behaviours during babble to early words in two aspects namely in the type of sounds used by the babbler as well as the manner in which these sounds are organized temporally. They conclude that babbling is the crucial first developmental phase towards adult speech production ability.

The following questions then arise: which sounds are employed in babbling and how and in what order does the sound repertoire develop in babbling? The data gathered from the literature addressing these issues will now be discussed.

2.3.4 An overview of previous research on sound acquisition.

An overview of the research attempting to identify early sounds as they occur is provided in Table 2.2. The studies are ordered according to the chronological age of the subjects in each study.

In the first tabulated study Kent & Murray (1982) studied 21 babies, each for a 20 day period. The subjects were aged 3 , 6 or 9 months respectively. They studied vowel as well as consonant sounds. They found that the number of vowel sounds increased before the age of 8 months with a relative mid-front - central place of production and that the consonant-vowel ratio were becoming gradually more even during the 4-8 months age range.

Consonant sounds like [ɦ; ʔ] decreased from 97.1% at 3 months to 70.4% at 9 months of age. With regard to place of articulation, apical placement was preferred to dorsal placement.

Davis & MacNeilage (1995) also documented the mid/low and front/ventral vowels to be the most frequently occurring, in their subjects of 7 months of age. With reference to manner of production of consonants, alveolars and labials were preferred over nasals and stops were preferred over fricatives.

Mitchell & Kent (1990) found that vowels formed 41.2% of all utterances in their subjects of 7 - 11 months. These vowels varied in place of production.

They found CV syllables the most frequent syllable structure, with repetitive and reduplicated babbling present. Changes in syllable structure followed the following pattern of change: repetitive CV syllable, first changed in its manner of production and eventually in place of production over time.

Oller, Wieman , Doyle & Ross (1975) studied 10 subjects. Five were between 1,0 and 1,1 years of age, the other five were between 6 and 8 months of age. They addressed consonant development in their study with no attention to the emergence of early vowels. They found unaspirated stops occurring more frequently than aspirated stops when they considered manner of articulation. Final obstruents were mostly voiced. Stops had a 10 to 1 representation ratio when compared to the frequency of fricatives or affricates. Final fricatives were 3 times more frequent than stops and spirates. Glides were identified , but did not occur frequently. Apical consonants were preferred over dorsal consonants with regards to place of articulation.

The study by Chapman (1991) included 10 subjects, 5 of whom had cleft lip and palate. The data of the normal subjects (ages 12,1-14 months) again showed, with regard to consonant production, that in the manner category stops formed 71% of the consonants and fricatives 14%. The alveolar-palatal place of articulation formed 68% of the consonants with the labial category at 12%.

These findings were confirmed by Kent & Bauer (1985) with their 5 subjects aged 13 months. Stops formed 74% of the consonant sound productions, followed by fricatives at 11%. Bilabial and apical places of articulation occurred most frequently, followed by velar-uvular, palatal, glottal and pharyngeal placement. Vowels formed 60% of utterances and again the central and front vowels were most frequent,; low vowels did, however increase. Their examination of syllable structures indicated that the most frequent syllable structure was CV (at 19%), followed by CVCV (8%), VCV (7%) and VC and CVC (2%). Structures like VCCV, VCVCVC and CVCVC did not occur.

Roberts (1979) studied one subject from the age of 1,11 to 2,1 years of age. He found that the preferred final vowel was preferred to be [i]. Medial and final consonants were preferred to dental consonants. Medial consonants develop in structures having a consonant followed by a vowel (C+) or a vowel with a consonantal offset (-C).

A pioneering study by Velten (1943) studied the speech development of a subject from the age of 11 months through 3 years of age. Velten found that the initial syllable structure was VC. The VC syllable allowed for a totally open onset due to the vowel with its unconstricted airway, followed by a totally closed offset through the consonant.

As the subject developed he was able to incorporate smaller phonetic distinctions into the VC syllable. Continuants [m,n,s,b] and labial spirates developed first, usually followed by a second stop, then a second continuant. The second vowel sound did not emerge before the following sequence of consonants were established in the subject's sound repertoire [p m t n] . Another combination of consonants that may occur before the second vowels' emergence is [p f t s].

The following development in the subject's sound repertoire was the discrimination between voiced and unvoiced sounds. Velten reported that by the age of 22-24 months, the subject had 9 phonemes, the voiced vs. unvoiced distinction and , additionally, [b d m n].

Other noteworthy data that were tabulated in Table 2.2 was Stark's (1996) comment that the syllable structure CVCV was a prerequisite for acquiring more complex syllabic forms in speech development.

Irwin (1947) reported that the first vowel is [æ] and that it emerges within the first 10 days. Front and medial vowels are favoured and in the first month [i;ɛ;ʌ] are found in the infant's vowel repertoire. He lists the consonants occurring in the infants sound repertoire at 5-6 months of age as [b;m;w;d;n;ɹ].

Two other early studies namely Templin (1957) and Jacobson (1941) indicate that stops emerge earliest , followed by continuants. Jacobson (1941) states that back nasals are replaced by [n] as development occurs and that in terms of consonant contrasts, oral to nasal contrasts occur initially ([p] and [m]). Labial to dental contrasts follow; [p t m n] are the next consonantal contrast to develop. These two instances of consonant contrast form the minimal consonantal system.

Table 2.2 A Summary of the data from speech development literature on sound acquisition from 3 months to 24 months of age.

Authors	Subjects		Vowels	Consonants			Syllable structure
	Age	Number		Symbol	Manner	Place	
Kent & Murray (1982)	3,6,9 month old infants observed in 20 days	21 babies	3-9 months : relatively mid-front-central vowels occur vowels increase before 8 months v:c ratio: • 0-2months: 4,5:1 • 2-4months: 3,6:1 • 4-8months: 2,8:1 front vowels preferred over back vowels	[h and ʔ] at 3 months constituted 87.1% of consonants at 6 months they formed 75.3% of consonants at 9 months they constituted 70.4% of consonants	no data	apical consonants preferred over dorsal consonants	no data

Davis & Macneilage (1995)	7 months and up	6	no single vowel preferred mid/low and front/central vowels	d m b n g w	oral stops produced first, then labial stops, followed by nasal stops infrequent fricatives produced glides present but infrequent	alveolars and labials produced first, then nasals	no data on the syllable structures of the babbling sequences
Mitchell & Kent (1990)	0,7 - 0,11 months	8	41,2% of utterances were vowels; the vowels were varied in place				cv utterances occurred in varied and reduplicated form repetitive babble was dominant the changes in babble occurred as follows: repetitive babble followed by manner changes, then mixed babble, followed by place changes in babble

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Oller, Wieman, Doyle & Ross (1975)	1,0 - 1,1 years and 0,6 - 0,8 months	10 (5 in each category)		singletons occurred frequently	more unaspirated than aspirated stops final obstruents mostly voiced stops : fricatives / affricates : 10:1 final fricatives: stops and spirates: 3:1 glides more frequent than liquids apical more frequent than dorsal consonants	initial consonants more frequent than final consonants	
Chapman (1991)	12,1 - 14 months	10 (5 normal and 5 with cleft lip and / or palate)		d constituted 55% of consonant repertoire g constituted 9% h " 9% w " 5% j " 4% b " 3%	stops formed 71% of consonant repertoire, fricatives formed 14%, glides formed 9%, nasals formed 6% and affricates formed 2%	alveolar-palatal constituted 68% of consonants produced, labial constituted 12%, velar-uvular constituted 11% and glottal constituted 10%	
Kent & Bauer (1985)	13 months	5	• central and front vowels occurred most frequently • low vowels increased • vowels formed 60% of utterances	voiced frontal stop (bilabial and apical) occurred with highest frequency	stops formed 74% of consonants fricatives in syllable final position constituted 11% of consonants nasals formed 10% glides formed 5%	bilabial and apical occur first, then velar and uvular, followed by palatal, then glottal, and lastly pharyngeal	cv : 19% of production repertoire of subjects cvcv: 8% vcv: 7% vc:2% cvc: 2% vccv:0% vcvc: 0% vcvcv:0% cvcvc:0%

Roberts(1979)	1,11 - 2,1 years	1	final vowel that was preferred [i] (palatal)			medial and final consonant preferred a dental place of articulation medial consonants develop in structures having c + or +c or both	consonant harmony priority of vowel harmony both dependent on initial consonant + final consonant contrast develops in vc structures different vowel systems develop in vv / vcv structures

Velten (1943)	11-36 months	1 subject					vc occur first : total closure to total open vocal tract smaller phonetic distinctions then develop continuant [m n s b / labial spirate develop, followed by a 2nd stop, a second vowel does not emerge before p m t n or p f t s are established in the sound repertoire voiced / unvoiced discriminations the occur 22-24 months: 9 morphemes present with the distinction between voiced / unvoiced established. additional sounds that occur at this stage: b m d n
Stark(1996)							identified the cvcv syllable structure as important and a starting point for learning more complex forms

Irwin (1957)			[æ] first 10 days, followed by [i; ε; ʌ] front and medial vowels in the 1sr month: [i ; ε]	consonants in the first 5 -6 months of life: p m w d n			
Templin (1957)					stops early continuants later allophones do occur		
Jacobson (1941)			first vowel contrast wide to narrow [a - i] or contrast of palatal& velar a i u to central [a ; I; e] these contrasts form the minimal vowel set of any language		stops occur first they are replaced by fricatives back nasals are replaced by [n]	the first consonant contrast is oral-nasal [p - m], followed by labial - dental contrast [pt, mn] these contrast form the minimal consonant system of any language	

2.3.5 The organization of early sounds in a particular order in babbling.

The questions arising from this section relate to the overall organization of babbling patterns. This organization has not been clearly determined.

Despite the extensive literature on early sounds, there has not been a systematic attempt to explain why the first sounds emerge first and why particular consonants co-occur with particular vowels more regularly than with other vowels. Further aspects that are in a similar vein that have not been addressed are the reason why babblers favour consonants in the onset and vowels in the off-set position in utterances.

Davis & MacNeilage (1995) endeavoured to address the organization of babbling by stating that the co-occurrence of certain vowels with certain consonants can be explained by their "Frame then Content" hypothesis. According to these authors, the organization of the babbling utterance is dominated by a Frame. The Frame is provided by the rhythmic opening and closing alternation of the mandible. They suggest that the main contribution to the CV syllable in babbling is made by the mandible. They demonstrate the mandible contribution with the following examples of CV co-occurrences:
tongue front consonants [d t n j] co-occur with front vowels
tongue back consonants [g k] co-occur with back vowels
labial consonants [b p m w] co-occur with central vowels
In the first two cases, it was suggested that the tongue might occupy a similar position relative to the mandible throughout the syllable, while in the third example, the tongue might stay in a neutral position. The Frame then Content hypothesis highlights the motor skill and the movements involved in a babbling sequence , instead of overemphasizing the linguistic aspects such as consonants, vowels and phonemes.

This way of thinking is supported by Kent & Murray (1982) when they state that instead of describing vocalization behaviour and babbling in terms of the linguistic aspects through phonological analysis, babbling could be described in terms of the observed and inferred movements of articulatory structures.

Davis and MacNeilage (1995) ascribed the CV structures to the observed and inferred movements of the mandible.

Kent & Murray (1982) argue that what a linguistic perspective perceives as a CV syllable in the babbling of an infant, is a movement sequence in which the articulatory structures move from a position that constricts the vocal tract to a non-constricted position. This explains why babbling utterances exhibit a consonantal onset (constriction of the vocal tract) and a vocalic off-set (the so-called non-constricted position). Kent & Murray (1982) confirm the Frame then Context hypothesis (Davis & MacNeilage, 1995) of mandible dominance by stating that the most sound patterns classified by linguistic studies as syllables are generated by single unidirectional articulatory movements rather than multiple, sequential articulatory movements. It is clear that attention to the movements in babbling will assist in describing the organization of babbling.

The second type of evidence for babbling as a movement sequence can be gathered from the type of babbling that occurs in each utterance. MacNeilage & Davis (1990b) suggest that most of the variation involved in variegated babbling utterances (i.e. utterances in which successive CV syllables are not identical) might be vertical i.e. made by changes in mandibular oscillations. This results in vowels that will differ mostly in height and consonants might differ mostly in amount of constriction. In contrast, relatively little variation might be horizontal, due primarily to the tongue's movement in the front -back dimension. Trends consistent with this explanation of variegated babbling were identified in all subjects from studies conducted by Davis & MacNeilage (1994,1995). This framework is adhered to in the Speech Facilitation Program as well as the Speech Motor Learning Program as the variation levels of each stage implements reduplicated and variegated babbling.

There have been other attempts to determine the co-occurrence of certain consonants with particular vowels in babbling. A summary of the research is presented in Table 2.3

Tal le 2.3 The co-occurrence of sounds and sequential patterns found in bal bling as described in the literature.

RI :SEARCHERS	SUBJECTS		FINDINGS
	Number	Ages	
Elber 1982	not available	Not available	They observed a fixed order in babbling: single sounds occurred first, then reduplicated babbling followed. Manner of articulation changes occur next, followed by place of articulation changes (front, central and back).
Bickl y 1983	14	14-22 months at 3 month intervals	Evidence is presented of development of vowel height before backing There is a predominance of mandibular movement over jaw movement The infant's control over degree of mouth opening precedes motor skill that allows tongue's anterior vs. posterior placement
Hodg 1989		7.5 - 9.5 month old	Children are accomplishing opening and closing gestures with greater relative contribution of mandibular than lingual movement.
Smith et al. Stoel- jammon 1989	10	6-9 months 10-13 months 14-17 months	They described the following rank orderings in their subjects: At 6-9 and 10-13 months of age: reduplicated babbling occurs first, then place variegation develops, followed by manner variegation At 14-17 months: place variegation occurs, then manner variegation, followed by reduplication of utterances
Davis & MacNeilage 1990	1	14-20 months	Co-occurrence of C and V patterns in consonant-vowel combinations that were maintained in their subject were: Alveolar Consonants with front Vowels; Labial Consonants with central Vowels; Velar Consonants with back Vowels.
Mitch ll& Kent 1990		7,9,11 months	Manner of articulation changes predominate over place of articulation changes. Reduplication occurs first, then manner of articulation changes, then mixed place and manner of articulation changes, followed by place of articulation changes
Vihm n 1992	23		The following co-occurrence patterns in consonant-vowel combinations were observed: Labial Consonants with central Vowels Velar Consonants with back Vowels
Boyss on-Bardies 1993	Groups of 5 representing four languages	10-12 months old	The following co-occurrence patterns of consonant-vowel combinations were found in 4 languages: French: dental Consonants with front Vowels and labial Consonants with central Vowels; English: labial Consonants with front Vowels

			And dental Consonants with front Vowels; Swedish: dental Consonants with front Vowels and labial Consonants with central Vowels; Yoruba: dental Consonants with central Vowels and labial Consonants with central Vowels.
Boysson-Bardies 1993	4 language groups		Vowel 1 and vowel 2 of the utterance have similar height and front dimensions. If Vowel 1 differs from vowel 2in the utterance, similar height and front/back dimensions are maintained in 3/4 of languages There is more control of the height dimension than the front/back dimension by the subjects.
Oller & Stefans 1993	4	10-12 months	They observed the following co-occurrence patterns in consonant-vowel combinations: Coronal Consonants with front / high Vowels; Dorsal Consonants with back Vowels; Labial Consonants with low Vowels.
Davis & MacNeilage 1994		7-12 months	Co-occurrence of the following consonant-vowel combinations were found: Tongue front Consonants with front Vowels Labial Consonants with central Vowels

Because of the methodological differences, the varying age groups of the subjects, the varying number of subjects, the different languages acquired by the subjects as well as the length of the experimental phases of these studies, no conclusions can be reached beyond the superficial. From the research, it is clear that there are some indications that certain consonants co-occur with certain vowels. It is not clear when this co-occurrence emerges in the infant. Some hypothesize it to be with the onset of variegated babbling.

There are, however, other researchers that believe variegated babbling occurs at an earlier stage than previously documented and therefore the co-occurrence issue is further complicated by the uncertainty surrounding the particular time of emergence of reduplicated and variegated babbling. Traditionally, consecutive stages of babbling were identified namely reduplicated babbling (sequences of identical CV syllables) and variegated babbling (different segments occur in successive syllables). A number of recent studies have suggested that, contrary to earlier belief (Oller, 1980; Stark, 1980), variegated babbling does not become frequent in the later stages of babbling, but, instead, is common from the beginning (cf. Smith, Brown-Sweeney and Stoel-Gammon, 1989; Mitchell & Kent, 1990; Davis &

MacNeilage, 1994,1995). Variegated babbling was considered a more advanced form of babbling than reduplicated babbling - hence the later occurrence. But if variegated babbling is viewed from a context of "Frame dominance" (Davis & MacNeilage, 1995) and a movement approach, it is clear that variegated babbling can occur from early on.

There are, however, some researchers that agree that changes in the height dimension is easier and precedes changes in the front-back dimension of the oral cavity (Bickley, 1982; Boysson-Bardies, 1993; Hodge, 1989). This confirms the Frame then Content hypothesis (Davis & MacNeilage, 1995) that emphasizes the relative contribution of the mandible to early babbling.

It seems that the researchers could not identify any universal co-occurrence patterns of consonant-vowel combinations. Each study that has been documented in Table.2.3 observed different co-occurrence patterns. The idea of universal co-occurrence patterns in consonant-vowel combinations should, however, not be dismissed due to varying results. The results in each study tabulated in Table 2.3 are influenced by the ages of the particular subjects, the language environment and language stimulation of each subject in each study (some research was conducted on a single subject) and by the transcription of consonants and vowels in their particular front/back and high/low dimensions.

2.3.5 Implications for the Speech Facilitation Program.

The sounds that are selected for the Speech Facilitation Program are based on literature reports of sounds that are universally acquired first during speech development. The Frame then Content Hypothesis (Davis & MacNeilage, 1995) ,that posits that the main contribution to the consonant-vowel syllable is made by the mandible ,will be addressed in the selection of some of the consonants and vowel combinations in the Speech Facilitation Program (for example the [b] and [m] in Stage 1). The use of reduplicated as well as variegated CVCV structures will be implemented as early as Stage 1 in the Speech Facilitation Program as the variation levels of the existing SMLP also address reduplicated and variegated structures from Stage 1. In the selection and compilation of target words at each level, the use of reduplicated and variegated utterances will ,therefore, be present because the target vocabulary, phrases and sentences will share the same CVCV structures as does the nonsense syllables.

2.4 Summary of Chapter 2.

This chapter dealt with the theoretical orientation towards the compilation of a Speech Facilitation Program aimed at developing and enhancing speech production. The area of motor learning and speech motor learning were discussed as it related to the existing Speech Motor Learning Program on which the Speech Facilitation program is based. The suitability and adaptations of the SMLP to a universal Speech Facilitation Program were also addressed.

Normal speech development of the infant was examined in terms of its influence on the selection and sequencing of the target sounds of the Speech Facilitation Program. The different stages and possible co-occurrence patterns of certain vowels with certain consonants in early babbling were discussed in terms of its implications for the compilation of the syllable structures of the Speech Facilitation Program.

Chapter 3

Research Method

3.1 Introduction

The aim of the study is twofold. The first aim is to develop a universal speech facilitation program as an extension of the Speech Motor Learning Program and the second aim is its application in an experimental alternating treatment study. The two aims will be discussed separately as Phase 1 (the development of the speech facilitation program) and Phase 2 (its application in an alternating treatment design).

3.2 Phase 1: The development of a universal speech facilitation program.

3.2.1. Research Aims

- To identify the initial consonants and vowels as they emerge in major languages in early speech and to order them in a universal developmental sequence.
- To apply the format of the SMLP (Van der Merwe, 1985) to the selected sounds and sound combinations and develop a universal speech facilitation programme according to this format i.e. long-term stages as well as variation levels, core vocabulary and phrases at each of the stages.

3.2.2 Procedure for the development of a universal speech facilitation program.

3.2.2 1 Literature study

Review of the findings of the literature study was aimed at determining the order of sounds as they appear sequentially during speech development. The literature study findings were described in detail in Chapter 2 in Table 2.2.

The data that was gathered from the literature study did not render a clear and precise order of sounds that were identical or very similar across all languages. There were similarities that could be identified, but often these were very general and pertained to a group of sounds and not specific sounds as they emerge in an infant's language. The different studies, furthermore, had varying methodologies, different age ranges in their subjects and the number of subjects for each study was different. For the purpose of this study, the most representative order and sequential pattern had to be identified for the selection of sounds at each stage of the speech facilitation program. Based on the available data a basic sequence was determined for the sounds of the speech facilitation program. The sounds (consonants and vowels) that were selected for the SFP are listed in Table 3.1

Table 3.1 The consonants and vowels that were selected for the Speech Facilitation Program

SOUNDS OF THE SPEECH FACILITATION PROGRAMME	
Consonants	Vowels
b d m n f k t p v g	/a u I ɛ /

The consonants were selected as follows: The first three sounds consisted of a voiced bilabial stop [b], a bilabial continuant sound [m] and a voiceless, mid-alveolar stop [d]. These sounds were identified in the literature as occurring first in the production of infants acquiring most languages. The voiceless, labio-dental [f], the mid-alveolar nasal continuant [n] and the voiceless velar stop [k] also often occurred within the first group of sounds to emerge. The remaining selection consisted mostly of the voiced or unvoiced counterparts of some of the sounds.

No sequential appearance of single vowel sounds over time was reported for any language. A set of vowels representative of the universal basic vowel classification was therefore included in the SFP. The set of vowels comprises [a] (mid vowel), [i](high front vowel), [ε] (mid-low back vowel) and [u] (high back vowel).

3.2.2 2 Determining the long-term stages of the universal speech facilitation program.

The original SMLP has ten stages, but for practical purposes some adjustments were necessary for the development of a universal speech facilitation program. There were basic requirements that the SFP had to meet in order to address its purposes as described in Chapter1, namely that it should be simple to use, allow for utilisation by both professionals and non-professionals and have the least possible language restrictions. The various stages of the SMLP were then adapted to ensure that the SFP is short enough to be practical, economical to distribute to communities and other professionals and the content not too complicated to follow.

The adaptation was especially indicated when considering that the SFP was aimed at the young child in the initial stages of language acquisition. The more complex and mature forms included in the SMLP would be beyond the primary scope of the SFP. The program is intended to address the basic syllable structures and universal sounds found in early speech. The material should not be language specific, or client specific because the SFP is indeed a facilitation procedure aimed at the young child's speech development.

The first stage starts with the first three target consonants. In the following stages, the other sounds are added to these first three consonants one by one so as to expand the production repertoire gradually (See Table 3.2).

3.2.2.3. Application of additional features of the SMLP to the SFP

- *Variation Level*

There are five variation levels at each stage of the SMLP and the variation levels were also applied in the SFP . The variation levels of the SMLP are as follows:

Variation level 1: Consonant (C) 1, Vowel (V) 1, C1, V+

Variation level 2: C1, V1, C2, V+

Variation level 3: C1, V1, C+, V1

Variation level 4: C1, V+, C2, V1

Variation level 5: C1, V+, C+, V+

The '+" indicates that this particular sound varies within a sequence of units. See Chapter 2 for more detail.

- *Core vocabulary and phrases*

As in the SMLP, the SFP has a core vocabulary compiled from the target sounds of each stage to ensure that the newly acquired motor skill that has been mastered through the production of nonsense syllables are transferred at the earliest possible time to meaningful speech. The syllable structure that is targeted at the particular stage in the SMLP and in the SFP is also adhered to in the compilation of the core vocabulary and phrases.

3.2.3 Summarized version of the universal Speech Facilitation Program

The SF program is tabulated in Table 3.2

Table 3.2 A summary of the stages, sounds, syllable structures and core vocabulary of the SF Programme

STAGE	CONSONANTS	VOWELS	SYLLABLE STRUCTURE	VARIATION LEVEL	CORE VOCABULARY (AFRIKAANS)	CORE VOCABULARY (ENGLISH)
1	b d m		CVCV	1-5	5 words	5 words
2	n b d m		CVCV	1-5	5 words	4 words
3	f n b d m		CVCV	1-5	4 words	5 words
4	k f n b d m		CVCV	1-5	18 words	14 words
5	t k f n b d m		CVCV	1-5	13 words	12 words
6	p t n f k b d m		CVCV	1-5	9 words	8 words
7	v t p n f k b d m		CVCV	1-5	3 words	9 words
8	g v p t n f k b d m		CVCV	1-5	25 words	18 words
9	G v p t k f n m d b		CVC	1. C1 V+C1 2. C1 V1 C+ 3.C+ V1 C1	44 words	30 words

There are nine stages in the SFP. Each level has target sounds (consonants and vowels) and a particular syllable structure. At each of the stages, there are five variation levels that were adopted from the SMLP. At each of the stages, a core vocabulary was developed using the sounds of each stage. The quantity of words in the core vocabulary, therefore, is variable according to the number of words that can be constructed in each of the stages and their sub-stages while adhering to the specific syllable structure used in the stage. The core vocabulary was developed in Afrikaans and in English, but for the purpose of the study only the Afrikaans words were used during treatment as both the subjects were mother tongue speakers of Afrikaans. A brief summary of the SFP will be provided as an appendix as the content of the SFP is too extensive to include in its entirety.

3.3 Phase 2: Application of the universal speech facilitation programme in an alternating treatment design study.

3.3.1. Research aims

3.3.1.1. Main aim

To apply the speech facilitation programme in an alternating treatment design study in order to determine if this programme does facilitate certain aspects of speech development.

3.3.1.2 Sub aims.

To determine if speech and certain other aspects of communication development were facilitated to the same extent by both the treatment approaches with regard to:

- **Durational aspects of speech production**
  - *Utterance Duration (UD)*
  - *Vowel Duration (VD)*
  - *Voice-Onset-Time (VOT)*
- **Speech Intelligibility**
- **The presence of phonological processes**
- **The occurrence of different syllable structures**
- **Certain aspects of language ability related to form, content and use**
  - *Mean Length of Utterance (MLU) as a measure of language form*
  - *The number of different words in relation to the total number of words (Type-Token-Ratio TTR) as a measure of language content*
  - *Certain aspects of pragmatic development as a measure of language use*

3.3.2. Experimental design

An alternating treatment design (ATD) was employed in the experimental phase of this study. The purpose of the ATD is a comparison of two or more treatments' effectiveness in changing one behaviour (McReynolds and Kearns,1983). In this study, it was attempted to demonstrate experimental control of speech improvement versus language improvement through treatment with the Speech Facilitation Program (SF-Treatment). The ATD provided a method to compare two procedures namely SF-Treatment versus a more language based approach (LT-Treatment).

Counterbalancing, the alternation of treatments and as such eliminates the effect of one treatment always following another (order effects), was achieved when Subject 1 initially received treatment A (SF-Treatment) and Subject 2 received treatment B (LT-Treatment). The treatments were alternated after a certain number of sessions were completed.

The ATD is, however, not able to provide the experimenter with absolute statements, only relative judgements. Its strength lies in its evaluation of differences between effectiveness of treatments when two are offered, not in the evaluation of the effectiveness of one treatment per se. The application of the ATD in the present study is tabulated in Table 3.3

Table 3.3: The Schematic representation of the experimental phase of the study that employed the alternating treatment design.

TREATMENT PERIOD 1	
Subject 1 – SF-Treatment (A)	Subject 2 – LT Treatment (B)
Pre-treatment baselines (3)	Pre-treatment baselines (3)
Speech Facilitation Treatment	Language Treatment
Probe Test (1)	Probe Test (1)
Speech Facilitation Treatment	Language Treatment
Probe Tests (3)	Probe Tests (3)
Counterbalancing i.e. switch treatment	
TREATMENT PERIOD 2	
Subject 1 – LT-Treatment (B)	Subject 2 – SF-Treatment (A)
Language Treatment	Speech Facilitation Treatment
Probe Test (1)	Probe Test (1)
Language Treatment	Speech Facilitation Treatment
Probe Tests (3)	Probe Tests (3)

Phase 2 of the study commenced with three pre-treatment baseline administrations of the Probe test. Subject 1 commenced treatment with the Speech Facilitation Program, while Subject 2 received language therapy. During this treatment period, another probe test was administered to each of the subjects. The respective treatment continued for a certain time period and then 3 consecutive probe tests were administered following the first treatment for each of the subjects. The treatments were then alternated, i.e. counterbalancing occurred. Subject 1 subsequently received treatment with language therapy and Subject 2 with the Speech Facilitation Program. During this treatment period a probe test was administered to each of the subjects. Treatment continued and following the allocated time period, the experiment was concluded with another 3 consecutive probe tests administered to each of the subjects following their respective treatments.

3.3.3. Subjects

Three children with normal development and two children with speech and language delay were included as control and experimental subjects respectively.

3.3.3.1 Criteria for subject selection

General criteria

All of the subjects in the experimental and control groups had to fit the following criteria:

- They had to be first language speakers of Afrikaans, with no other language spoken in the home, in order to eliminate the influence of language confusion in any circumstance.
- They had to be between 2.9 and 3.6 years of age to ensure that early speech development could be facilitated and in the case of the controls described.

- They had to have normal hearing of at least 15 dB pure-tone threshold average with no indication of middle ear pathology at the onset of the study, to ensure that the baseline performances obtained for each subject is representative of their true level of functioning.
- No neurological impairment should be present since such impairments could dramatically influence the interpretation of results in the study.
- No motor or sensory impairment such as cerebral palsy or blindness should be present that could dramatically influence the results obtained in the study.
- Normal cognitive development should be present to ensure that the normal developmental patterns occurring in children in the above age group can be anticipated and used as norm.

Criteria for inclusion in the control group.

A control group will be selected to represent normal speech and language development for young children and therefore their speech and language development should be judged as normal by a qualified speech language therapist / audiologist.

Criteria for inclusion in the experimental group.

- Speech and language development should be judged as delayed by a qualified speech language therapist / audiologist, and there should be no organic dysfunction, deafness or other diagnosed speech or language disorder present.
- The subjects were required to be comparable with regard to speech and language stimulation in their everyday environment, because differing circumstances could influence the communication development of a child in a positive or negative way. It could discredit progress or relapses in treatment if changes in communication competence might be ascribed to differing stimulation in the home environment. .
- The subjects should share a similar socio-economic background.

- Ages should be within 3 months of each other to enable some comparison of speech and language performance between subjects, including the effects of normal development.
- Subjects were required to show a marked delay of up to six months on the following assessment instruments: Language Acquisition Remediation and Screening Profile (LARSP) by Crystal, Garmant & Fletcher (1979) and an Afrikaans Translation of the Peabody Picture Vocabulary Test – Revised (PPVT-R) by Dunn & Dunn (1981) in order to ensure the presence of a speech and language delay.

3.3.3.2 Procedure for subject selection

The selected assessment instruments were administered to each potential subject to determine whether s/he met the inclusion criteria for the experimental group.

Material for subject selection

The LARSP(Crystal, Garmant & Fletcher, 1979) was conducted as prescribed in the manual.

An Afrikaans translation of the PPVT-R (Dunn & Dunn, 1981) was conducted as prescribed in the manual.

3.3.3.3 Description of subjects

3.3.3.3.1 Control group

Three subjects were selected who had normal speech and language development for their age. Information on the three control subjects is provided in Table 3.4.

3.3.3.3.2. Experimental group

Two members of a set of triplets with delayed speech and language development were selected. A brief case history follows:

The subjects were born by caesarean section at 27 weeks gestation age, categorising them as born with extreme prematurity. Both remained in hospital for 2 months after their birth. They were fed via a naso-gastric tube for the duration of their hospitalisation. Subject 1 remained on a ventilator for 2 and a half weeks after birth, while Subject 2 remained on the ventilator for 2 weeks after birth.

They received occupational therapy for their first two years of life. Paediatric follow-ups continued every three months for the first two years.

Subject 2 received grommets for middle ear infection at the age of 1 year.

No major illnesses were reported by the parents in the first three years of life.

During the study, Subject 2 and subsequently Subject I contracted German Measles during their holiday. According to their mother, they did not seem to be feeling ill at all, but showed the rash. During a routine hearing check-up following a bout of tonsillitis by Subject 2 during the change of season, Subject 2 developed middle ear infection and underwent a myringotomy with symptoms clearing directly afterwards. During the holiday period of two weeks (and the accompanying illnesses) the subjects did not receive any treatment.

The triplets attended an Afrikaans nursery school and their treatment started 3 weeks into their attendance. They had adjusted well to the nursery school environment, as the three members of the triplet were placed in the same class and participated with each other in activities. Following the school holiday, the triplets were moved to a nearby Afrikaans nursery school. According to the mother, they showed no problems adjusting as the triplets were again placed together in class. A summary of biographical data is provided in Table 3.4.

Table 3.4 Summary of biographical descriptive data of the subjects.

SUBJECT	AGE AT ONSET OF EXPERI– MENT	HOME LANGUAGE	LANGUAGE ENVIRONMENT	SEX	SPEECH AND LANGUAGE PERFORMANCE
EXPERII-MENTAL SUBJECT 1	3,0 YEARS	AFRIKAANS	AT THE ONSET OF THE STUDY: ATTENDS AFRIKAANS NURSERY SCHOOL IN THE MORNING WITH 5 OTHER CHILDREN IN THE CLASS; AT HOME WITH MOTHER IN THE AFTERNOON HALFWAY THROUGH THE STUDY THE SCHOOL CLOSED DOWN AND THE TRIPLET WAS CONSEQUENTLY MOVED TO ANOTHER AFRIKAANS NURSERY SCHOOL WHERE THEY ATTENDED MORNINGS WITH 10 OTHER CHILDREN IN CLASS.	FEMALE	LARSP (CRYSTAL, GAMANT & FLETCHER, 1979) – LEVEL 2 PPVT-R (DUNN & DUNN, 1981) – 2 YEARS 1 MONTH AFRIKAANSE ARTIKULASIETOETS (LOTTER, 1974) – OMISSION OF THE /R/ IN ALL POSITIONS IN WORDS AS WELL AS IN CLUSTERS CONTAINING /R/.
EXPERII-ME-NTAL SUBJECT 2	3,0 YEARS	AFRIKAANS	AFRIKAANS NURSERY SCHOOL IN THE MORNING WITH FIVE OTHER CHILDREN IN THE CLASS; AT HOME WITH MOTHER IN THE AFTERNOON	MALE	LARSP (CRYSTAL, GARMANT & FLETCEHR, 1979) – LEVEL 2 PPVT-R (DUNN & DUNN, 1981) – TWO YEARS NIL MONTHS AFRIKAANSE ARTIKULASIETOETS (LOTTER,1974) – OMISSION OF THE /R/ SOUND IN ALL POSITIONS IN WORDS AS WELL AS IN CLUSTERS CONTAINING THE /R/
CONTROL SUBJECT 1	3 YEARS , TWO MONTHS	AFRIKAANS	AFRIKAANS NURSERY SCHOOL IN THE MORNING WITH 15 OTHER CHILDREN IN THE CLASS; AT HOME WITH MOTHER IN THE AFTERNOON	MALE	JUDGED AS NORMAL BY A SPEECH-LANGUAGE THERAPIST
CONTROL SUBJECT 2	3 YEARS, 3 MONTHS	AFRIKAANS	AFRIKAANS NURSERY SCHOOL IN THE MORNING WITH 8 OTHER CHILDREN IN THE CLASS; AT HOME WITH MOTHER IN THE AFTERNOON	FEMALE	JUDGED AS NORMAL BY A SPEECH LANGUAGE THERAPIST
CONTROL SUBJECT 3	3 YEARS, 3 MONTHS	AFRIKAANS	AFRIKAANS NURSERY SCHOOL IN THE MORNING WITH 8 OTHER CHILDREN IN THE CLASS; AT HOME WITH MOTHER IN THE AFTERNOON	MALE	JUDGED AS NORMAL BY A SPEECH-LANGUAGE THERAPIST

3.3.3.4 Criteria for inclusion in the listener panel for the intelligibility rating

The listener panel should consist of professionals experienced in perceptual analysis speech samples.

3.3.3.5 Description of the listener panel for the intelligibility rating

The panel consisted of three senior lecturers at the University of Pretoria who have had extensive experience in perceptual analysis, auditory speech discrimination and the transcription of speech samples.

3.4 Experimental Procedure

3.4.1 Treatment with the Speech Facilitation Program

3.4.1.1 Treatment aims

Main aim: To increase the subjects' speech motor skills in order to facilitate and enhance speech development.

Sub aims

- To increase accurate production of the nonsense syllable units and sequences of syllables.
- To increase motor memory for the nonsense syllables in the program over a time period.
- To generalize the motor skills, acquired through the use of the SFP, to a core vocabulary initially with the aim of spontaneous generalization to speech production in general.

3.4.1.2 Procedure and material for treatment with the Speech Facilitation Program

The long-term stages of the SMLP were applied as described in 3.2.2.2.

At each of the stages, treatment was conducted according to the variation levels of each stage. The steps of treatment of the SMLP were used for each variation level in each stage (See Chapter 2 for more detail).

The standard procedure for the sequence of sessions can be described as follows:

- The examiner produces each unit before the subject starts to practice it, in order to set an auditory example and an auditory target.

- Each unit is drilled separately through repeated production of the unit. Repetitions continue until a criterion of 5/5 correct productions of the unit is attained. Correct production is defined as:
- Accurate articulation with no distortion
- Consistently accurate production with no variation between repetitions.
- Initially slowed rate of production with increased rate while maintenaning accurate production.

- Rewards were used during each treatment session. For each sequence that was produced correctly, the subject was allowed to string a bead, to colour a petal of a flower picture or to paste a sticker onto a sticker chart. As treatment progressed, the criteria for a reward were increased. The subjects had to produce an increased number of repetitions of the sequence correctly before they were allowed to paste, colour, string etc. .

- After the child is able to produce the unit, the unit is repeated after a certain time period to develop motor memory for the unit. The unit is repeated after 10 seconds and again after one minute.

- After the 5/5 criterion is reached, and the child is able to produce the unit the set time period, the length of the utterance is increased to form a sequence of units. First one unit is added to the sequence, then two, then three. Each addition is preceded by correct articulation of the previous unit.

- The speed of production of units and sequences is increased to normal speech rate while accurate articulation is maintained.

- The core vocabulary (words and phrases) is introduced during the session. The subject produces the target word following the auditory example of the examiner.

- The core words are embedded into phrases and sentences within an appropriate semantic context, such as a picture or a story where the child can spontaneously use the target words.

- At the start of the next session, the previous sessions' nonsense units are revised, or if the previous sessions ended with the practice of core words and phrases, they are revised.

- The examiner models the correct utterance to the child by saying:" Say baba."
- The child repeats [baba].
- The subject is instructed to add to the utterance:" Say baba, babu."
- The subject repeats the utterance. If the subject is able to produce the utterance, s/he is instructed to repeat the sequence independently for at least 3 repetitions.
- Another of the nonsense units in the sequence is added, for example [baba, babu, babi] according to the above format.

<u>3.4.2. Treatment using language therapy</u>

3.4.2.1 Treatment aims

Main aim

Improvement of receptive and expressive language performance through the implementation of indirect stimulation techniques.

Sub aims

- The improvement of language content, form and use in both receptive and expressive language modalities.

- The improvement of auditory skills through auditory skill training: listening posture and sequential memory for events.

Aim structures

Language content: To increase the child's vocabulary and conceptual knowledge through the use of thematic material

Language form: To extend the child's current utterances to an age appropriate level regarding morphology and syntax.

Language use: To establish age appropriate turn taking ability on a specified topic, to increase the child's turn in conversation to more than responses and single word utterances, and also to apply the newly acquired vocabulary in a semantically appropriate context.

Auditory skills: To introduce a whole body listening approach (Kline, 1991) for the duration of each session. To develop sequential memory for events that are in chronological order in order to establish a causal link between events.

3.4.2.2. Procedure and material for Language Therapy Treatment.

Input, revision and feedback techniques (De Mayo, 1988) are used in the following manner. The child's lead is followed at all times. When the child remains silent, the researcher applies the following input techniques to elicit responses:

- self talk (the researcher imitates the child's action and describes it),
- parallel talk (the researcher and child talk in parallel fashion about their own activities) or
- modelling (the researcher models the appropriate utterance when the child's attempt is unclear).

Revision techniques (De Mayo, 1988) are used as a follow-up and extension of the child's communicative attempt. The child's utterance is either expanded on, or expatiated (the child's concept will be developed further) or the utterance is replaced by an age appropriate utterance.

The child receives feedback on the success of his/her communicative attempt when the researcher imitates the child's utterance either partially or completely.

These techniques are used interchangeably with each other depending on the child's level of initiations and responses. Selected age appropriate reading books, which are theme related, are used. Drawing paper, crayons, theme related single pictures, photographs, glue, scissors, string, wool and stringing beads are also utilised.
The themes implemented during language therapy treatment are tabulated in Table 3.5.

Table 3.5 The themes that were used during language therapy treatment.

THEME	TARGETED VOCABULARY
Farm	• Animals on the farm and their functions • Diminutives • Gender • Farm crops • Farm implements
Holiday	• Locations • Activities • Accessories • Opposites
Winter	• Temperature • Clothing • Activities
Pets	• Kinds of pets • Food • Habitat • Body parts
Clothing	• Names • Seasonal dressing • Colours and textures
Family	• Names and Roles • Appearance • Character traits

3.4.3 Duration of sessions

Each treatment session lasted 25 minutes with an extra 5 minutes allowance for packing up, and settling down.

3.5 The Probe Test

The probe test was administered as consecutive pre-treatment baselines as well as inter-treatment evaluations.

3.5.1 Application of the probe test

Ten aspects were included in the probe test that was applied to determine the level of progress made during treatment (See Table 3.6). The aims of the probe test were to compare the effects of SF-Treatment and LT-Treatment and, secondly, to examine how the performance of Subject 1 and 2 compared to the values obtained by the normal controls.

A specific order was adhered to during the application of each of the probe tests for Subject 1 and Subject 2 . Table 3.6 provides an overview of the aspects that were tested, the activity used for the elicitation of each aspect as well as the material and instructions that were used during the probe test.

The test includes ten different aspects and to prevent confusion each aspect of the probe test will be discussed separately in terms of:

- definition ,
- theoretical motivation for inclusion in the probe test,
- data collection ,
- data analysis and
- data processing.

Table 3.6 The Probe Test: Aspects, activities, material and instructions.

ASPECT THAT WAS TESTED	ACTIVITY THAT WAS USED FOR ELICITATION OF THE ASPECT	MATERIAL USED FOR THE ELICITATION OF THE ASPECT	INSTRUCTIONS GIVEN TO THE SUBJECT
1.Utterance Duration	Word repetition following the presentation of a real object or a line drawing and/ or the researcher's modeled example.	Line drawings and real objects representing 14 selected words from the Afrikaanse Artikulasie Toets (Lotter, 1974) The words were: Baba Seep Boom Lepel Mielie Vurk Tafel Deur Neus Piesang Kat Geld Fiets Jas	• The subject was requested to name the object based on the presentation of a line drawing taken from the Afrikaanse Artikulasie Toets (Lotter, 1974). If the subject could not comply, the real object was presented to the subject and the prompt repeated. • The prompt: " What is this?" was used with the presentation of the object. • If the subject was able to produce the name of the object, s/he was requested to repeat the word with the prompt: " Say it again". • If the subject was unable to produce the name of the object from presentation of the object, the examiner modeled the word and said: " Now, you say that". If the subject then produced the word, he was requested to repeat the word with the prompt: " Say it again.". • The real objects were phased out as soon as possible and the words were elicited from the line drawings of the words. The same instructions were given as with the real objects.
2.Vowel Duration	Word repetition	The first vowels of the 14 words of the Afrikaanse Artikulasie Toets (Lotter, 1974) via line drawings and real objects representing the 14 words	As above
3.Voice-Onset-Time	Word repetition	Initial voiced plosives in three of the 14 words selected from the Afrikaanse ArtikulasieToets (Lotter, 1974) elicited as explained above. The three words are:: • Baba • Boom • Deur	As above
4. Diadochokinesis (DDK)	Syllable repetition	Consecutive repetitions of: [p t] for 5 seconds and [p t k] for 5 seconds	• The examiner demonstrated [p t] by explaining that the subject should imitate the sound of rain on the roof. The examiner demonstrated slowly and rhythmically and tapped with her hand on the table while producing the syllables. • The subject was then requested to perform the task with the prompt: "Now you try for as long as you can." • The hand of the subject was held

			and tapped while speaking in unison with the subject. As soon as the subject grasped what was expected and produced the syllables independently, the tapping was terminated and the researcher stopped producing the syllables. • The same procedure was followed for [p t k] except that the examiner explained that is was the sound of hail on the roof that is imitated. • The tapping and speaking in unison was phased out as soon as possible and the subjects were merely instructed to produce the rain or the hail on the roof-sounds.
5.Inteligibility rating	Spontaneous speech sample	A variety of developmentally appropriate material namely story books, sequence cards, doll's house, finger puppets, tea set, clay, dolls and clothing were selected and one of these developmentally appropriate activities were used during the recording of the spontaneous speech sample .	No formal instructions were given to the subjects during the recording of a spontaneous speech sample. The material was placed between the examiner and the subject and conversation was initiated usually by the subjects who asked: " What is this?" or " It is a....". The recording was made for 15 minutes. The analysis of the particular aspect was conducted following the probe test.
6.Phonological Process Analysis	As above		
7.Syllable structure Analysis			
8.Mean Length of Utterance			
9.Type-Token-Ratio			
10.Pragmatic Screening			

3.5.2 Utterance duration (UD) as one of the aspects of the probe test

3.5.2.1 Theoretical Motivation

Temporal aspects of speech production such as utterance duration (UD) and also vowel duration (VD) are, according to Martin (1972) and Michon (1974), critical in skilled motor actions (such as speech production). DiSimoni (1974 a, b, and c) found evidence that young children are very variable in their speech timing, hence the fluctuation in duration measurements of their speech production. According to DiSimoni (op. cit.) the variability in duration decreases with age and that the influence of context as well as the length of segmental durations start to emerge between 3 and 6 years of age, causing the control of duration to develop rapidly in the age range of 3-6 years.

Kent (1976) states that timing variables such as UD and VD could provide a sensitive metric for the evaluation of neuromuscular maturation and agreed that the most rapid changes occur between 3 and 6 years. According to Tingly and Allen (1975) , timing in various motor tasks (speech and non-speech) indicates that a progressive refinement of control occurs. Duration measurements were, therefore, included as aspects of the probe test to determine whether the subjects showed a progressive acquisition of speech timing evident in their duration measurements and also whether any of the treatment options provided to them accelerated this process.

3.5.2.2 Data collection

The data collection procedure for UD of Subject 1, Subject 2 and the normal controls is summarized in Table 3.7.

Table 3.7 Data Collection Procedure for UD

MATERIAL	EQUIPMENT	PROCEDURE
• Real objects representing 15 words of the Afrikaanse Artikulasie Toets (Lotter, 1974) • Line drawings of the same 15 words of the Afrikaanse Artikulasie Toets (Lotter, 1974)	• Marantz Model CP230 / CP430 Stereo Cassette Recorder • Electret Condenser Tie-clip omni-directional microphone • 90 minute TDK Audio Cassette	• The microphone was attached to the subject's clothes 15 cm from the mouth when looking straight ahead. Recordings were made in a quiet room at the University clinic on three occasions and the remaining probe tests were recorded at their Nursery school in a quiet room. The tie-clip microphone was used for practical reasons so that the subjects would not be restricted in movement during play activities and the mouth-microphone distance could be sustained. • The VU level of the cassette recorder was monitored carefully to not exceed pre-distortion levels. The VU level was checked at the onset of each probe test by requesting the subject to say a few words and monitoring the VU level before the recording was started. • The recording was started and for the three recordings at the University clinic, an assistant

		monitored the VU-level. The examiner monitored the VU-level at the recordings that were made at the Nursery School. • The instructions were described in Table 3.6 under Instructions of UD • The subject had to repeat each word twice

3.5.2.3 Data Analysis

The data analysis procedure followed for Subject 1, Subject 2 and the normal controls is summarized in Table 3.8.

Table 3.8 Data analysis of UD

MATERIAL	EQUIPMENT	PROCEDURE
Recording paper	• Computerized Speech Lab (CSL) Model 4300B – Kay Elemetrics Corporation • Marantz Model CP 22230 / CP 430 Stereo Cassette Recorder • Beyerdynamic DT211 Hi-Fi Stereo Headphones	• Of the two repetitions, each subjects' most representative example of hs/her usual production of the 14 words of the Afrikaanse Artikulasie Toets(Lotter, 1974) was selected. • The sampling rate of the CSL was set at 20000 Hz • UD of each of the 14 words was measured from the commencement of the first visible acoustic energy of the first consonant, or in case of a stop sound with a negative voice onset, at the beginning of the voice onset. • For UD, the end of the word was determined by finding the termination of spectral energy i.e. the point that can no longer be regarded as speech energy. Care was taken to consider the preceding acoustic activity and where it no longer seemed to be present. • The acoustic signal was displayed as a waveform and a wideband spectrogram and both displays were taken into account for the duration measurement. • The acoustic signal was stored in the digital memory of the CSL.. • The time cursors were utilized to determine the duration of the word in milliseconds

3.5.2.4 Data Processing

- *For Subject 1 and 2:*

- The absolute values of each word in each probe test were recorded for Subject 1 and 2 for the duration of the study and tabulated. For each of the three baseline measures a mean value was calculated for each baseline.

- *For Control 1,2 and 3:*

- The UD of the normal controls were added and a mean value was obtained and tabulated.

- The range of UD was calculated for the normal controls in terms of the highest and lowest UD value.

3.5.3 Vowel Duration (VD) as one of the aspects of the probe test

3.5.3.1 Theoretical Motivation

As Utterance Duration

3.5.3.2 Data Collection

Data collection was conducted in an identical manner as for UD.

3.5.3.3 Data Analysis

The data analysis described below in Table 3.9 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.9 Data analysis of VD

MATERIAL	EQUIPMENT	PROCEDURE
Record sheet	As with UD	• The most representative example of VD of the first vowel of the subject's two repetitions of the 14 words of the Afrikaanse Artikulasie Toets (Lotter, 1974) was taken • The sampling rate of the CSL was set at 20000 Hz • VD was measured for the selected word from the commencement of the first striation of the first vowel following the consonant. • The end of the vowel was determined by finding the termination of spectral energy that can no longer be regarded as the vowel. Care was taken to consider the preceding acoustic activity and where it no longer seemed to be representing a vowel i.e. lack of periodicity and unclear visibility of the first and second formant. • The acoustic signal was displayed as a waveform and a wideband spectrogram • The acoustic signal was stored in the digital memory of the CSL. • The waveform and the spectrogram was used for the vowel duration measurement. • The time cursors were utilized to determine the duration of the vowel in milliseconds

3.5.3.4 Data Processing

- *For Subject 1 and 2:*
- The absolute values of the vowel duration of each word in each probe were recorded for Subject 1 and 2 for the duration of the study and tabulated. For each of the three baseline measures a mean value was calculated.
- *For Control 1,2 and 3:*
- The VD of the normal controls were added and a mean value was obtained and tabulated.

- The range of VD was calculated for the normal controls as being the highest and lowest VD value.

3.5.4 Voice-Onset-Time (VOT) as one of the aspects of the probe test

3.5.4.1 Theoretical Motivation

Interarticulator synchronisation was examined as a further aspect of timing in addition to absolute duration of the utterance and of the first vowel.

3.5.4.2 Data Collection

The data collection procedure was identical to that of UD and VD.

3.5.4.3 Data Analysis

The data analysis procedure described in Table 3.10 was followed for Subject 1, Subject 2 and the normal controls.

Table 3.10 Data analysis of VOT

MATERIAL	EQUIPMENT	PROCEDURE
Record sheet	As with UD and VD	• VOT was measured for the production of three words that had voiced plosives in the word initial position namely baba, boom and deur. • VOT was measured from the release of the plosive to the commencement of the first striate on the spectrogram that represent glottal pulsing (Lisker & Abrahamson, 1964) • The commencement of the plosive was regarded as the graphic nil point and the voice onset after the plosive obtained a positive notation, while the voice onset preceding the plosive obtained a negative notation.

3.5.4.4 Data Processing

- *For Subject 1 and 2:*

- The absolute values of the VOT of each of the words in each probe were recorded for Subject 1 and 2 for the duration of the study and tabulated. For each of the three baseline measures a mean value was calculated.

- *For Control 1,2 and 3:*

- The VOT of the normal controls were added and a mean value was obtained and tabulated.
- The range of VOT was calculated for the normal controls as being the highest and lowest VOT value.

3.5.5 Diadochokinesis (DDK) as one of the aspects of the probe test

3.5.5.1 Theoretical Motivation

DDK of two and three syllable utterances were included as a measure of articulatory skill to determine if SF-Treatment had any effect on the rate and accuracy of the productions when compared to another treatment namely LT-Treatment. DDK gives an indication of the underlying strength, speed, range, direction as well as the timing of speech muscle activity (Darley, Aronson & Brown, 1975). The DDK of the subjects was also compared to the DDK of the normal controls.

3.5.5.2 Data Collection

The data collection procedure described in Table 3.11 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.11 Data collection of DDK measures

MATERIAL	EQUIPMENT	PROCEDURE
Record sheet	As for UD, VD and VOT plus • Stopwatch	Please see Table 3.6 (Instructions for DDK)

3.5.5.3 Data Analysis

The data analysis described below was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.12 Data analysis of DDK measures

MATERIAL	EQUIPMENT	PROCEDURE
Record sheet	As for UD, VD and VOT plus • Stopwatch • Beyerdynamic DT211 Hi-Fi Stereo Headphones	• The number of repetitions of the syllables were calculated by counting the productions in 5 seconds

3.5.5.4 Data Processing

- *For Subject 1 and 2:*
- The number of repetitions by Subject 1 and 2 were counted for [p t] and [p t k] for each probe and tabulated.
- *For Control 1,2 and 3:*
- The number of repetitions of the normal controls were counted for [p t] and [p t k] respectively and tabulated. From the table, a range was calculated as being the lowest and highest number of repetitions for [p t] and [p t k].
- The number of repetitions for pete and peteke were counted respectively for each subject at each of the probe tests and tabulated.

3.5.6 <u>Intelligibility rating as one of the aspects of the probe test</u>

3.5.6.1 Theoretical Motivation

According to Kent (1992), intelligibility is the key factor that needs to be documented when treatment outcomes, in this particular study SF-Treatment and LT-Treatment, are considered for children with delayed speech development. This measure provides an index for speech motor ability according to Yorkston, Beukelman & Bell, 1988).

3.5.6.2 Data Collection

The data collection referred to in Table 3.13 was adhered to for Subject 1and Subject 2. The control subjects were used as a referencing point from where to rate the intelligibility of the subjects.

Table 3.13 Data Collection used in the intelligibility rating

MATERIAL	EQUIPMENT	PROCEDURE
Spontaneous speech sample	As UD, VD, VOT and DDK	Please see Table 3.6 (Instructions for Intelligibility Rating)

3.5.6.3 Data Analysis

The data analysis referred to in Table 3.14 was adhered to for Subject 1 and Subject 2. The controls were used as a referencing point from where to rate the intelligibility of Subject 1 and 2.

Table 3.14 Data Analysis used in the intelligibility rating

MATERIAL	EQUIPMENT	PROCEDURE
A Speech intelligibility rating form was compiled for use by the listener panel members It consisted of a space for subject 1 or 2, a number of presentation of the speech sample and rating scale from 1 to 7. 1 was described as completely unintelligible and 7 as being just as intelligible as the normal controls. A REMARK section was added to the rating scale.	• Marantz Model CP 22230 / CP 430 Stereo Cassette Recorder • Speakers • Audio cassettes with the spontaneous speech samples of the subjects and controls	• The rating occurred over a three-day period. • The tapes were not played in a chronological order • Speech samples of the three normal controls were played to the panel members until they were confident of the controls' intelligibility as a referencing point for the subjects. • Subject 1's spontaneous speech sample was presented first for approximately 2 minutes and the listener panel rated each sample by consensus. • After every fourth presentation of the subject's speech sample, the sample from the normal controls was presented again. • The same procedure was followed for Subject 2. • The listener panel re-convened the following day and some of the speech samples were presented again to determine within- and between -rater reliability.

3.5.6.4 Data Processing

The scores of each listener panel member was recorded and tabulated. For the three baselines, mean values were calculated as a reference point against which the probe tests could be compared.

3.5.7 <u>Phonological process analysis as one of the aspects of the probe test</u>

3.5.7.1 Theoretical Motivation

A phonological process analysis was included in the study because it contributes to the identification of consistent patterns in speech behaviour (Lund & Duchan, 1983). It was employed to determine if SF-Treatment had any effect on the type and frequency of processes occurring when compared to LT-Treatment, and also to compare the phonological development of the experimental subjects to the phonological development of the normal controls.

3.5.7.2 Data Collection

The data collection referred to in Table 3.15 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.15 Data collection of the phonological process analysis

MATERIAL	EQUIPMENT	PROCEDURE
As for Intelligibility rating	As for UD, VD, VOT, DDK , Intelligibility rating and syllable structure analysis	As described in Table 3.6 under Instructions for Phonological Process Analysis

3.5.7.3 Data Analysis

The data analysis procedure tabulated in Table 3.16 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.16 Data analysis of phonological process analysis

MATERIAL	EQUIPMENT	PROCEDURE
Record Sheet	• Marantz Model CP 22230 / CP 430 Stereo Cassette Recorder • Audio cassettes with the spontaneous speech samples of the subjects and controls	• The spontaneous speech sample was transcribed • The 20 most representative utterances were selected for analysis from each probe. It consisted of the middle twenty utterances of each spontaneous speech sample. • Any occurrence of phonological processes was noted and described according to the guidelines in Lund & Duchan (1989). • It was noted if the process, if present, is age appropriate or below the age norm for the normal controls as well as the subjects • Two speech samples of each subject as well as a speech sample of the normal controls were analyzed by an independent speech therapist to ensure between-rater reliability of results.

3.5.7.4 Data Processing

It was noted if any type of phonological processes occurred and if it did occur whether the presence or the frequency of occurrence of the process in the speech sample of the subjects showed any changes that could be ascribed to SF-Treatment when compared to LT-Treatment. The speech samples of the subjects were compared to the speech sample of the normal controls.

3.5.8 Syllable structure analysis as one of the aspects of the probe test

3.5.8.1 Theoretical Motivation

An analysis of different syllable structures was included in the study to determine which syllable structures occurred with the highest frequency in each probe test and if the SF-Treatment had any effect on the frequency of syllable structure compared to LT-Treatment. The syllable structures that occurred in the speech of the normal controls were also compared to the syllable structures found in the speech samples of the experimental subjects.

3.5.8.2 Data Collection

The data collection tabulated in Table 3.17 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.17 Data collection of the syllable structure analysis

MATERIAL	EQUIPMENT	PROCEDURE
As for Intelligibility rating and phonological process analysis	As for UD, VD, VOT, DDK, Intelligibility rating and phonological process analysis	As described in Table 3.6 under Instructions for Syllable structures

3.5.8.3 Data Analysis

The data analysis procedure referred to in Table 3.18 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.18 Data analysis of Syllable Structures

MATERIAL	EQUIPMENT	PROCEDURE
Record Sheet that listed different categories of syllable structures namely • CV • VC • CVC • VCV • CVCV • VCVC • CVCVC • OTHER (Longer than CVCVC or different from the above categories)	• Marantz Model CP 22230 / CP 430 Stereo Cassette Recorder • Audio cassettes with the spontaneous speech samples of the subjects and controls	• The speech sample was transcribed phonetically using the International Phonetic Alphabet with all the words below each other • Consonants were identified as C • Vowels were described with V • Diphthongs were identified as VV • Consonant clusters were identified with CC or CCC depending on the cluster e.g. sl- or str- • In a cluster where reduction occurred the cluster was transcribed as it was produced by

		the subject for example /skr-/ to /sk-/ was transcribed as CC instead of CCC. • If a sound in a cluster was substituted for another sound, that sound was identified as a C or V depending on the sound. • Two speech samples of each subject, as well as speech samples of the normal controls were analyzed for syllable structure by an independent speech pathologist to determine interrater- reliability. The findings correlated with the findings of the researcher.

3.5.8.4 Data Processing

- *For Subject 1 and 2:*

- The number of entries into each syllable structure category was converted to a percentage of the total number of different structures for each of the subjects in each of their probe tests and tabulated.

- *For Control 1,2, and 3:*

- The number of entries into each syllable structure category was converted to a percentage and tabulated.

3.5.9 Mean Length of Utterance (MLU) as one of the aspects of the probe test

3.5.9.1 Theoretical Motivation

MLU was included as a quantitative measure of language form that measures the average number of morphemes in a speaker's utterance(Owens, 1991).

3.5.9.2 Data Collection

The data collection procedure referred to in Table 3.19 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.19 Data collection of MLU

MATERIAL	EQUIPMENT	PROCEDURE
As for Intelligibility rating ,syllable structure and phonological process analysis	As for UD, VD, VOT, DDK , Intelligibility rating, syllable structure and phonological process analysis	As described in Table 3.6 under Instructions for MLU

3.5.9.3 Data Analysis

The data analysis described below was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.20 Data analysis of MLU

MATERIAL	EQUIPMENT	PROCEDURE
Record sheet	• Calculator • Marantz Model CP 22230 / CP 430 Stereo Cassette Recorder • Audio cassettes with the spontaneous speech samples of the subjects and controls	• The speech sample was transcribed • The number of morphemes were counted • The following were excluded in the counting: imitations, elliptical answers, partial utterances, unintelligible utterances, rote passages, false starts, reformulation, noises, fillers, identical utterances (Owens, 1991). • The following were counted as one morpheme: contractions, diminutives and plurals • The following were counted as more than one morpheme: regular past tense, contractions that occur as two forms elsewhere in the speech sample • The number of morphemes were divided by the total number of utterances for the MLU

3.5.9.4 Data Processing

- *For Subject 1 and 2:*

- The MLU was calculated for Subject 1 and 2 and displayed.
- The MLU's of the subjects were compared to the MLU of the normal controls, as well as to two sets of literature findings namely the stages identified by Brown (Brown, 1973) and norms developed by Miller & Chapman (1981).

- *For Control 1,2 and 3:*

- The MLU was calculated for the normal controls.
- The range of MLU of the normal controls was calculated i.e. the lowest and highest MLU value.

3.5.10 Type-Token-Ratio (TTR) as one of the aspects of the probe test

3.5.10.1 Theoretical Motivation

TTR was included as a quantitative measure of language content that measures the relationship between the total number of words and the total number of different words in a speech sample (Shipley & McAfee, 1992). The TTR provides an indication of the diversity of the words that the subjects used. It is employed in this study to determine if SF-Treatment had any effect on TTR as a measure of language content when compared to LT-Treatment, and secondly how the TTR of the subjects compared to the normal controls.

3.5.10.2 Data Collection

The data collection procedure referred to in Table 3.21 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.21 Data collection of TTR

MATERIAL	EQUIPMENT	PROCEDURE
As for Intelligibility rating, syllable structure and phonological process analysis as well as MLU	As for UD, VD, VOT, DDK , Intelligibility rating, syllable structure and phonological process analysis as well as MLU	As described in Table 3.6 under Instructions for TTR

3.5.10.3 Data Analysis

The data analysis procedure tabulated in Table 3.22 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.22 Data analysis of TTR

MATERIAL	EQUIPMENT	PROCEDURE
Record Sheet from Shipley & McAfee (1992)	• Marantz Model CP 22230 / CP 430 Stereo Cassette Recorder • Audio cassettes with the spontaneous speech samples of the subjects and controls	• The speech samples of the subjects and the normal controls were transcribed • The twenty most representative utterances were selected for analysis i.e. the twenty middle utterances of each spontaneous speech sample. • Traditionally the TTR was calculated with the examiner numbering every new word produced by the child and therefore, the last number written, is the number of different words produced which is then divided by

		the total number of words in the speech sample for the TTR • Stickler (1987) modified the TTR in that the different types of words could also be counted and not merely the new words as they occurred. • Eight different word types were used namely nouns, verbs, adjectives, adverbs, prepositions, pronouns, conjunctions, affirmatives / negatives (yes, no), articles and wh-words (Stickler, 1987). • The TTR was calculated by dividing the number of different words by the total number of words in the speech sample while obtaining some information on the different types of words represented in the spontaneous speech of the subjects and the normal controls. • Two speech samples of each subject as well as the speech samples of the normal controls were analyzed for TTR by an independent speech pathologist to determine interrater- reliability. The findings of her analysis correlated with the findings of the researcher.

3.5.10.4 Data Processing

- *For Subject 1 and 2:*
  - The TTR's of the subjects were calculated and noted.
  - The total number of words of each subject were counted for each probe test and displayed.
  - The total number of different words for each probe test was also displayed separately for each subject.
- *For Control 1,2 and 3:*
  - The TTR's of the normal controls were displayed.

3.5.11 <u>Pragmatic Screening as one of the aspects of the probe test</u>

3.5.11.1 Theoretical Motivation

A Pragmatic screening was included as a quantitative measure of language use in order to determine if SF-Treatment had any effect on pragmatic functioning when compared to LT-Treatment and secondly to determine how the experimental subjects compared to the normal controls with regard to the pragmatic skills they demonstrated.

3.5.11.2 Data Collection

The data collection referred to in Table 3.23 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.23 Data collection of pragmatic screening results

MATERIAL	EQUIPMENT	PROCEDURE
As for Intelligibility rating, syllable structure and phonological process analysis, MLU as well as TTR	As for UD, VD, VOT, DDK , Intelligibility rating, syllable structure and phonological process analysis, MLU as well as TTR	As described in Table 3.6 under Instructions for Pragmatic screening

3.5.11.3 Data Analysis

The data analysis tabulated in Table 3.24 was adhered to for Subject 1, Subject 2 and the normal controls.

Table 3.24 Data analysis of pragmatic screening results

MATERIAL	EQUIPMENT	PROCEDURE
Pragmatic screening Checklist with seven aspects adapted from a more comprehensive pragmatic screening checklist compiled by Shipley & McAfee (1992)	• Marantz Model CP 22230 / CP 430 Stereo Cassette Recorder • Audio cassettes with the spontaneous speech samples of the subjects and controls	• The speech sample of the subjects and the normal controls were transcribed • The twenty most representative utterances were selected for analysis i.e. the twenty middle utterances of each spontaneous speech sample. • Presence or absence of a behaviour was noted for each speech sample. • Verbal as well as non-verbal turns in the conversations were used and for this reason, the pragmatic screening was conducted immediately following the probe test for each subject as well as the controls. • Two speech samples of each subject as well as the speech samples of the normal controls were analyzed with the pragmatic screening checklist by an independent speech pathologist to determine interrater- reliability. The findings of her analysis correlated with the findings of the researcher.

3.5.11.4 Data Processing

- *For Subject 1 and 2:*
- Findings of the pragmatic screening were tabulated for each of the seven aspects in the checklist in each probe.
- *For Control1, 2 and 3:*
- It was noted whether the seven aspects in the pragmatic screening occurred consistently during the course of their spontaneous speech sample.

3.6 Summary of Chapter 3

This chapter described the research method that was employed during the two phases of the study. Each phase was discussed separately. Phase 1 was discussed in terms of the research aims and the procedure that were employed to compile the Universal Speech Facilitation Program. Phase 2 was discussed in terms of the research aims, experimental design, subjects, procedure and the components of the probe test that were employed to determine the effectiveness of treatment with the Speech Facilitation Program.

Chapter 4

Description and discussion of results

4.1 Description and discussion of durational aspects

4.1.1 Description of Utterance Duration (UD) results

4.1.1.1 Utterance duration values obtained for the normal controls in the experimental phase of the study

The UD results of the normal controls are displayed in Table 4.1.

Table 4.1 **The calculated mean of the normal controls' utterance duration during the production of 14 selected words of the "Afrikaanse Artikulasie Toets" in msec.**

UTTERANCE DURATION OF CONTROLS IN MSEC		
Control 1	Control 2	Control 3
Mean: 1.358	Mean: 1.376	Mean: 0.734

The UD values of Control 1 and 2 differed by 0.016 msec., and may , therefore, be regarded as similar. Control 3 had a shorter utterance duration, but it did not have any effect on Control 3's intelligibility. (Please see Intelligibility results).

From these values, a range for the normal duration of utterance was obtained and used in the description of the experimental subjects' results. The normal range lies between 0.734 msec and 1.376 msec.

4.1.1.2 UD results for Subject 1

The UD results of Subject 1 are displayed in Table 4.2.

Table 4.2 **The absolute values for Subject 1's UD in msec of 14 selected words of the "Afrikaanse Artikulasie toets" as recorded during the different phases of the study.**

Word	BL1[1]	BL1	BL1	Ave of BL	SF	BL2	BL2	BL2	Ave of BL	LT	BL3	BL3	BL3	Ave of BL
baba	0.624	0.429	0.809	0.620	0.638	1.825	0.485	0.478	0.929	0.673	0.619	0.861	0.395	0.625
seep	0.882	0.234	0.663	0.593	0.490	1.353	0.818	0.876	1.015	0.848	0.476	0.503	0.364	0.447
boom	0.544	0.521	0.451	0.505	0.651	1.283	0.463	0.649	0.798	0.277	0.267	0.403	0.287	0.319
lepel	0.664	0.510	0.403	0.525	0.707	1.898	0.693	0.778	1.123	0.605	0.481	0.491	0.372	0.448
mielie	0.557	0.683	0.424	0.554	0.247	1.562	0.512	0.493	0.855	0.569	0.418	0.282	0.280	0.326
vurk	0.518	0.498	0.169	0.395	0.510	1.394	0.545	0.545	0.828	0.534	0.346	0.359	0.213	0.305
tafel	0.931	0.684	0.380	0.665	0.696	2.294	0.883	0.725	1.300	0.621	0.459	0.674	0.659	0.597
deur	0.958	0.564	0.367	0.629	0.538	1.130	0.460	0.543	0.771	0.492	0.779	0.303	0.195	0.425
neus	0.769	0.731	0.378	0.626	0.433	2.269	0.616	0.640	1.175	0.349	0.412	0.709	0.523	0.548
Piesang	0.739	0.569	0.471	0.593	0.449	1.253	0.604	0.605	0.820	0.442	0.392	0.300	0.457	0.383
kat	0.528	0.396	0.329	0.417	0.736	1.544	0.289	0.622	0.818	0.300	0.227	0.292	0.199	0.239
geld	0.877	0.524	0.343	0.581	0.749	2.096	0.957	0.968	1.340	0.856	0.279	0.743	0.689	0.570
fiets	0.498	0.524	0.735	0.585	0.324	2.109	0.759	0.740	1.202	0.854	0.843	0.656	0.546	0.681
jas	0.474	0.857	0.744	0.691	0.303	1.981	0.174	0.244	0.799	0.517	0.241	0.264	0.202	0.235

When Subject 1's absolute values were tracked over time for each word, the following trends were identified: The average of Pre-treatment baseline measures were shorter than those of the normal controls in all words. During SF- Treatment (Treatment with the Speech Facilitation program) ,UD increased in all words except for three (mielie, deur, jas) but the mean durations did not reach the normal range of the control subjects. Following SF-Treatment, UD increased in all words, with two words approximating normal values namely "geld" and "fiets". These increases could not be maintained when treatment was alternated. Some UD values even went below the initial pre-treatment levels. After LT-treatment was terminated, UD decreased in all except three instances.

[1] The abbreviations for the tabulated data are as follows: BL - Baseline; Ave of BL : the average of the three baseline values; LT : Language Treatment; SF: Speech Facilitation.

The absolute values for UD of Subject 1 were compared to the normal control's range of UD. During the pre-treatment baseline, 5 words were within normal range. In the SF treatment period, 2 words were within the normal range. Following SF 12 words were within the normal range. Only three words remained within the normal range when treatment was alternated to language therapy and at the termination of LT-treatment, two words were within the normal range.

Another method of examining the UD data of the subject is to add all the UD values of a probe together and divide the total by the total number of words. The obtained values are displayed in Figure 4.1.

Figure 4.1 Mean UD values of Subject 1 of each probe test in msec.

The baseline UD remained relatively stable. A dramatic increase in UD could be observed following SF, but this increase could not be maintained after treatment alternation and UD measures went below pre-treatment levels at the termination of all treatment.

4.1.1.3 UD results for Subject 2.

The absolute UD values are tabulated in Table 4.3.

Table 4.3 **The absolute values for Subject 2's UD in msec of 14 selected words of the "Afrikaanse Artikulasie toets" as recorded during the different phases of the study.**

Word	BL1	BL1	BL1	Ave of BL	LT	BL2	BL2	BL2	Ave of BL	SF	BL3	BL3	BL3	Ave of BL
Baba	0.873	1.146	0.403	0.807	0.662	0.608	0.749	0.688	0.681	0.594	0.590	1.011	0.558	0.719
Seep	0.777	1.707	0.452	0.978	0.817	0.843	0.781	0.663	0.762	0.864	0.455	0.467	1.256	0.726
Boom	0.571	0.851	0.376	0.599	0.715	0.496	0.536	0.568	0.508	0.349	0.536	0.544	0.476	0.319
Lepel	0.787	0.686	0.787	0.753	1.076	0.698	1.071	0.877	0.882	0.913	0.565	0.981	0.999	0.848
mielie	0.941	0.560	0.599	0.700	0.423	0.677	0.567	0.449	0.564	0.521	0.423	0.643	0.423	0.496
vurk	0.859	1.084	0.762	0.901	0.974	0.936	0.443	0.604	0.661	0.531	0.426	0.860	0.751	0.679
tafel	0.825	1.005	0.564	0.798	0.622	0.807	0.978	0.896	0.893	0.674	0.450	1.158	0.722	0.776
deur	0.525	1.173	0.700	0.799	0.321	0.616	0.464	0.841	0.640	0.574	0.281	0.778	0.726	0.595
neus	0.555	0.644	0.746	0.648	0.769	0.696	0.555	0.713	0.654	0.702	0.514	1.229	0.804	0.849
Piesang	0.420	0.443	1.044	0.635	0.482	0.500	0.640	0.397	0.512	0.402	0.472	0.756	0.337	0.521
kat	0.602	0.206	0.360	0.389	0.417	0.536	0.457	0.540	0.511	0.201	0.384	0.566	0.600	0.516
geld	0.843	0.643	1.164	0.883	0.589	1.325	1.088	1.088	1.167	0.625	0.825	0.968	1.641	1.144
fiets	0.918	1.140	0.925	0.994	0.443	0.870	0.667	0.371	0.636	1.131	0.853	0.861	0.780	0.831
jas	0.474	0.642	0.575	0.563	0.575	0.628	0.596	0.605	0.609	0.630	0.462	0.797	0.597	0.618

No clear trends could be identified in the absolute UD values of Subject 2. At the onset of the experimental phase, UD values were below the normal when compared to the UD of the controls in the study. During LT treatment , UD decreased in 8 words and increased in 6. Following LT treatment, increases could be observed in 9 of the 14 words, yet still below the normal values. Increases occurred in 5 instances during SF-Treatment. Following SF-Treatment, 8 words had increased UD values.

The absolute values of Subject 2's UD were compared to the normal controls' range of UD. During the pre-treatment baseline, 8 words were within normal range. In the LT treatment period, 3 words were within the normal range. Following LT treatment, 7 words were within the normal range. Eight words remained within the normal range during SF treatment and at the termination of SF-treatment, six words were within the normal range.

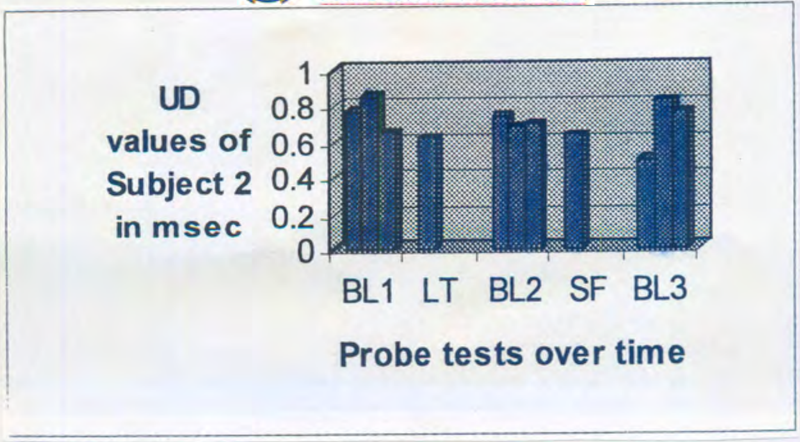

Figure 4.2 Mean UD values of Subject 2 of each probe in msec.

There seems to be no clear trend in the mean UD values of Subject 2. Gradual increases and decreases occurred with no clear indication of how any treatment influenced the subject's UD.

4.1.2 Description of Vowel Duration (VD) results.

4.1.2.1 VD values obtained for the normal controls in the experimental phase of the study.

The VD results for the normal controls are displayed in Table 4.4

Table 4.4 **The calculated mean of the normal controls' vowel duration in the production of 14 selected words of the "Afrikaanse Artikulasie Toets" in msec.**

VOWEL DURATION OF CONTROLS IN MSEC		
Control 1	Control 2	Control 3
Mean: 0.502	Mean: 0.567	Mean: 0.229

As was observed in the UD values, Control 1 and 2's VD values lay in close proximity of one another. Control 3 had a shorter vowel duration, with no negative influence on intelligibility. (Please see Intelligibility results).

From these values, a range for the normal duration of vowels was calculated for comparisons to the experimental subjects' results. The normal range lies between 0.229 msec and 0.567 msec.

4.1.2.2 VD results for Subject 1

The VD results of Subject 1 are tabulated in Table 4.5.

Table 4.5 **The absolute values for Subject 1's VD of 14 selected words of the "Afrikaanse Artikulasie toets" as recorded over the experimental phase of the study in msec.**

Word	BL1	BL1	BL1	Ave of BL	SF	BL2	BL2	BL2	Ave of BL	LT	BL3	BL3	BL3	Ave of BL
baba	0.308	0.345	0.284	0.280	0.280	0.712	0.172	0.250	0.378	0.306	0.261	0.312	0.173	0.248
seep	0.235	0.095	0.176	0.168	0.091	0.339	0.215	0.387	0.313	0.241	0.103	0.115	0.113	0.110
boom	0.232	0.370	0.161	0.254	0.464	0.994	0.335	0.504	0.611	0.151	0.076	0.281	0.198	0.185
lepel	0.153	0.117	0.084	0.118	0.097	0.376	0.149	0.201	0.242	0.146	0.082	0.096	0.081	0.086
mielie	0.319	0.137	0.059	0.171	0.088	0.457	0.098	0.149	0.234	0.169	0.102	0.089	0.062	0.084
Vurk	0.103	0.180	0.125	0.136	0.116	0.491	0.224	0.277	0.330	0.143	0.123	0.123	0.077	0.107
Tafel	0.316	0.286	0.148	0.250	0.240	0.874	0.357	0.314	0.515	0.226	0.169	0.203	0.196	0.189
Deur	0.311	0.219	0.309	0.279	0.515	1.288	0.446	0.537	0.757	0.454	0.750	0.254	0.176	0.393
Neus	0.435	0.137	0.102	0.224	0.173	0.891	0.396	0.508	0.598	0.149	0.134	0.218	0.215	0.189
Piesang	0.140	0.134	0.130	0.134	0.077	0.312	0.104	0.111	0.175	0.101	0.091	0.070	0.089	0.083
Kat	0.252	0.207	0.177	0.212	0.072	0.382	0.083	0.348	0.271	0.162	0.133	0.104	0.120	0.119
Geld	0.440	0.178	0.089	0.235	0.053	0.301	0.449	0.451	0.400	0.107	0.086	0.070	0.051	0.069
Fiets	0.130	0.101	0.114	0.115	0.084	0.312	0.167	0.166	0.215	0.211	0.220	0.131	0.106	0.152
Jas	0.162	0.219	0.147	0.176	0.050	0.394	0.069	0.244	0.235	0.033	0.044	0.046	0.069	0.053

The subject's absolute values were tracked over the duration of the experiment. The initial pre-treatment baseline measures indicated shorter than normal VD when compared to the normal data. During SF-Treatment VD measurements decreased in all instances except for two words (boom and deur).VD in these two instances remained shorter than the VD of the normal controls. Following SF-Treatment, VD measurements showed increases in all instances. The VD calculated in "mielie" were the same as the VD mean of the control subjects. As in UD measurements, the increases could not be sustained when treatment was alternated to language therapy (LT) and shorter VD was measured in all instances. At the termination of all treatment, VD decreased in none of the words and increased in four. The increases did not render values similar to the normal data.

The absolute values of Subject 1's VD were compared to the normal control's range of UD. During the pre-treatment baseline condition a total of four words were within the normal range. During SF-Treatment, a total of two words were within the normal range. Following SF-Treatment, a total of 13 words were within the normal range. Only three words remained within the normal range during LT-Treatment, at the termination of LT-Treatment, only two words were within the normal range.

Another method of examining the VD data of the subject is to add al the VD values of a probe together and divide the total by the total number of words. The obtained values are displayed in Figure 4.3.

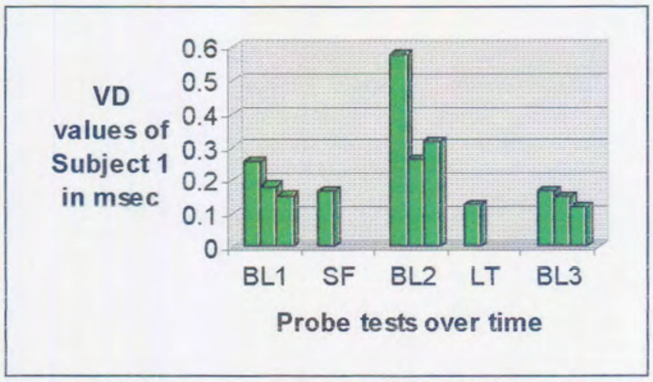

Figure 4.3 Mean VD values of Subject 1 for each probe test in msec

A similar pattern to that of the UD results was observed for this subject. The baseline VD remained relatively stable but a dramatic increase in VD could be observed following SF. However, the increase was not maintained and VD went below pre-treatment levels at the termination of all treatment.

4.1.2.3 VD results for Subject 2

The VD results for Subject 2 are tabulated in Table 4.6

Table 4.6 **The absolute VD values for Subject 2 in msec of 14 selected words of the "Afrikaanse Artikulasie toets" as recorded during the different phases of the study**

Word	BL1	BL1	BL1	Ave of BL	LT	BL2	BL2	BL2	Ave of BL	SF	BL3	BL3	BL3	Ave of BL
Baba	0.303	0.410	0.140	0.283	0.326	0.259	0.327	0.294	0.293	0.232	0.291	0.581	0.239	0.370
Seep	0.093	0.278	0.175	0.182	0.385	0.344	0.375	0.387	0.368	0.268	0.206	0.224	0.422	0.284
Boom	0.431	0.359	0.244	0.344	0.611	0.349	0.360	0.159	0.289	0.172	0.117	0.159	0.333	0.203
Lepel	0.631	0.190	0.254	0.358	0.303	0.233	0.261	0.198	0.230	0.186	0.149	0.278	0.182	0.203
Mielie	0.145	0.058	0.084	0.095	0.070	0.099	0.095	0.090	0.094	0.091	0.094	0.149	0.114	0.119
Vurk	0.175	0.189	0.253	0.205	0.083	0.311	0.123	0.287	0.240	0.259	0.046	0.519	0.118	0.227
Tafel	0.301	0.386	0.234	0.307	0.302	0.245	0.340	0.327	0.304	0.247	0.197	0.399	0.220	0.272
Deur	0.740	0.650	0.558	0.649	0.301	0.619	0.456	0.825	0.633	0.543	0.249	0.769	0.695	0.571
Neus	0.372	0.160	0.305	0.279	0.247	0.434	0.418	0.419	0.423	0.228	0.281	0.663	0.440	0.461
Piesang	0.045	0.083	0.157	0.095	0.073	0.054	0.061	0.068	0.061	0.057	0.073	0.100	0.063	0.067
Kat	0.207	0.121	0.163	0.154	0.147	0.185	0.142	0.143	0.155	0.157	0.135	0.343	0.160	0.212
Geld	0.109	0.101	0.102	0.104	0.097	0.232	0.253	0.267	0.250	0.182	0.269	0.370	0.236	0.291
Fiets	0.124	0.141	0.078	0.114	0.108	0.102	0.094	0.117	0.104	0.119	0.211	0.202	0.196	0.203
Jas	0.131	0.274	0.106	0.170	0.048	0.164	0.180	0.197	0.180	0.149	0.060	0.190	0.173	0.141

As in the UD results, no clear trends could be identified in the absolute VD values for Subject 2. At the baseline level, VD was shorter than normal with one exception (lepel). During LT-Treatment, which was applied first, only three words showed increases in vowel duration (baba, seep and boom) but the increases did not approximate normal VD data. Eight words showed vowel duration increases in the following LT measurements, but were again shorter than the normal controls' VD. During SF-Treatment 3 increases in VD were observed and at the termination of SF-Treatment, 7 words showed increases in VD from the previous measurements.

The absolute values of Subject 2's VD were compared to the normal controls' range of vowel duration. At the pre-treatment level, 5 words were within the normal range. During LT-Treatment, 5 words were within the normal range. Following LT-Treatment, 6 words were within the normal range. Three words remained within the normal range during SF-Treatment, and at the termination of SF-Treatment, 9 words showed VD values within the normal range.

When the VD values for Subject 2 were added and then divided by the total number of words in each probe, no clear trend could be observed. The findings are displayed in Figure 4.4

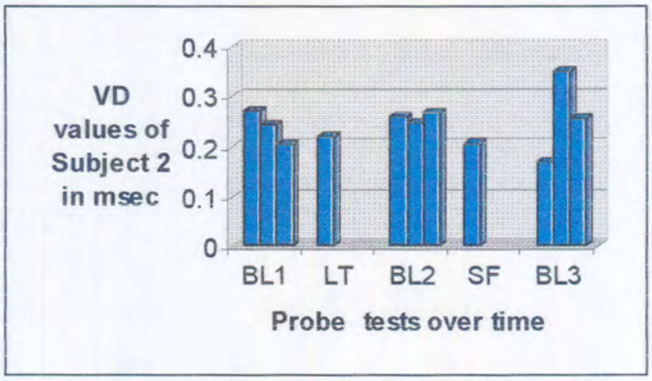

Figure 4.4 Mean VD values for Subject 2 for each probe test in msec

Gradual increases and decreases occurred without a clear indication of how any of the two treatments influenced the subject's VD. The values were very similar at the onset and at the termination of the experimental phase of the study.

4.1.3 Description of Voice-Onset-Time (VOT) results

4.1.3.1 Voice-onset-time values obtained for the normal controls

The VOT results of the normal controls are tabulated in Table 4.7.

Table 4.7 **The calculated mean of the normal controls' voice onset time during the production of 3 selected words of the "Afrikaanse Artikulasie toets" in msec**.

VOICE- ONSET- TIME OF CONTROLS IN MSEC		
Control 1	Control 2	Control 3
Mean: 0.038	Mean: 0.048	Mean: 0.005

4.1.1.2 *VOT results for Subject 1*

The VOT results for Subject 1 are tabulated in Table 4.8.

Table 4.8 **The absolute values of Subject 1's VOT of 3 selected words of the "Afrikaanse Artikulasie toets" as recorded over the experimental phase of the study in msec.**

Word	BL1	BL1	BL1	Ave of BL	SF	BL2	BL2	BL2	Ave of BL	LT	BL3	BL3	BL3	Ave of BL
Baba	0.007	0.001	0.007	0.005	0.020	-0.14	-0.01	0.007	-0.04	0.007	0.005	0.014	0.002	0.007
Boo m	0.001	0.002	0.004	0.002	0.106	0.023	0.009	0.017	0.016	0.006	0.006	0.005	0.002	0.004
Deur	0.000	0.005	0.008	0.004	0.017	0.019	0.005	0.012	0.025	0.024	0.011	0.035	0.002	0.016

Only negative values are indicated (-). The majority of the VOT measures were positive measures and are not indicated above. There were no VOT abnormalities present in Subject 1's productions and no further analyses were conducted.

4.1.3.3 *VOT results for Subject 2*

The VOT results of Subject 2 are tabulated in Table 4.9.

Table 4.9 **The absolute values for Subject 2's VOT of 3 selected words of the "Afrikaanse Artikulasie toets" as recorded over the experimental phase of the study in msec.**

Word	BL1	BL1	BL1	Ave of BL	LT	BL2	BL2	BL2	Ave of BL	SF	BL3	BL3	BL3	Ave of BL
Baba	0.000	0.001	0.004	0.001	0.004	0.005	0.008	0.007	0.006	0.009	0.008	0.005	0.005	0.006
Boo m	0.001	0.012	0.001	0.014	0.008	0.008	0.003	0.006	0.005	0.005	0.012	0.006	0.003	0.007
Deur	0.039	0.011	0.005	0.018	0.011	0.017	0.004	0.006	0.009	0.008	0.010	0.008	0.020	0.012

All VOT values were positive and there were no abnormalities present in Subject 2's VOT. No further analyses were conducted.

4.1.4 Discussion of acoustic measurements results

The durational measurements provided different results for each of the two subjects. In the case of Subject 1, it could be determined that in the probe conducted following SF-Treatment, the most dramatic approximations of normal values could be observed. This effect was observed in the UD as well as the VD results. When language therapy was conducted as a second treatment, the increases could not be maintained in either UD or VD measurements. The most likely reason for this could be that the SF-Treatment was conducted for too short a period of time to observe a more pronounced effect on duration during the different stages of the study. The one factor that precluded the extension of the study was that normal development occurred simultaneously, the subjects had no major health incidents, they were attending a nursery school and these are all positive indicators for development and catch-up growth to occur. The study had to be conducted in such a time frame that positive results could not be merely ascribed to normal development. The fact that duration measures returned to pre-treatment levels indicates that the changes that occurred can not be ascribed to developmental progress.

Subject 2 showed no dramatic changes in UD or VD measures with either form of treatment. VOT measurements in both instances were normal. Snow (1997) states that children's acquisition of sophisticated speech timing skills, as measured by acoustic measurements, occurs at different times in the course of development. Another possible explanation for this subject showing no reaction to the intervention with regard to durational aspects of speech could be based on gender. However, Lee, Potamianos and Narayanan (1999) found that gender had no significant effect on vowel duration or utterance duration.

The literature indicates that children, in general, have longer vowel and utterance duration than adults (Schwartz at al., 1996; Lee et al. , 1999; Kent & Forner, 1980) and that their speech production is characterised by greater variability. Neuromotor maturation is characterised by a systematic reduction in duration and also in a reduction of the variability of utterance repetitions and these reductions then constitute improvements in speech motor timing (Kent, 1976). In addition to neuromotor maturation, children gain more experience with speech production and the development in neuromuscular control of their articulators results in decreased variability and duration as a function of age. It has been recorded that slower speakers are more variable in their productions (Kent & Forner, 1980) and that reduction in segment duration occurs up to the first decade of life when duration measurements converge to adultlike values (Eguchi & Hirsch, 1969; Kent, 1976; Kent & Forner, 1980; Smith, 1992).

In this particular study, the subjects did not show longer than normal duration measurements, but instead shorter than normal durations. The subjects in most of the cited studies were older than the children in this particular study and , secondly, the subjects of the cited studies had normal speech and language development. The specific effect of a speech and language delay on very young children's duration is not clearly defined. In this particular case, the developmental delay seemed to have affected the duration measurements by causing shorter duration and by increasing variability across the experiment. The SF-Treatment seemed to affect the first subject's duration to approach normal limits after the treatment was terminated. It would be interesting to see if these "near normal" duration measurements following SF-Treatment would be found, along with the normal control's values, to be longer than the duration values of older children and adults.

There is some dispute in the literature regarding the relationship between duration and variability, and also regarding the decrease in both of these aspects as a function of age. Although longitudinal studies indicated that not all subjects show decreases in duration and variability over time (Smith, 1994; Robb & Tyler, 1995), group comparisons do indicate a 10% reduction in duration and a 40% reduction in variation over time (Smith, 1994). It is possible that duration (the rate of executing articulatory gestures) may be governed by a lower level skill, while variability (the organization for performing articulatory gestures) involves a higher level of skill. This relationship could explain the observation of greater variability from time to time, eventhough adult-like duration has been achieved as a results of basic neuromotor integrity (Smith, 1994).

The sample size of this study is too limited to make a group comparison to determine whether both or any of the subjects' duration and variability started to decrease over the course of the study. A further confounding aspect is that intervention was provided and that it was not merely a case of neuromuscular maturation of a normally developing young child. The subjects, furthermore, displayed speech and language delay (based on formal assessment as well as teacher report) and the study tried to determine which treatment had the most positive effect on duration measurements. No conclusions could be drawn in this regard although it was interesting to note the marked change resulting from speech facilitation treatment in Subject 1.

4.2 Description of Diadochokinesis (DDK) results

4.2.1 DDK values obtained for the normal controls

The DDK results of the normal controls are tabulated in Table 4.10.

Table 4.10 DDK Results obtained for the normal controls

NUMBER OF REPETITIONS BY THE NORMAL CONTROLS IN 5 SECONDS OF THE NORMAL CONTROLS			
Utterance	Control 1	Control 2	Control 3
/p t / in 5 sec	6	6	6
/p t k / in 5 sec	2	2	4

The three controls obtained identical scores for the two syllable utterance repetitions and therefore no range was calculated. Control 1 and 2 obtained identical scores for the three -syllable utterance while Control 3 produced twice the number of repetitions. The range for the three-syllable utterance is therefore between 2 and 4 repetitions.

4.2.2 DDK results for Subject 1

The DDK results for Subject 1 are tabulated in Table 4.11.

Table 4.11 DDK values for Subject 1 during the different stages of the study

NUMBER OF REPETITIONS BY SUBJECT 1 IN 5 SECONDS OF SUBJECT 1 DURING THE DDK TASK														
	BL1	BL1	BL1	MEAN	SF	BL2	BL2	BL2	MEAN	LT	BL3	BL3	BL3	MEAN
pete in 5 sec	3	2.5	2.5	2.6	4	4	3	5	4	4	5	5	4.5	4.8
peteke in 5 sec	2	2	1.5	1.8	2	3	2.5	2.5	2.6	2.5	3	2.5	3	2.8

The two-syllable utterance baseline was very similar and the subject could manage more repetitions of the two-syllable utterance, but below normal levels, than the three-syllable utterance. This remained constant throughout the different phases of the study. During SF-Treatment, the two-syllable utterance increased to four repetitions, still below normal levels, with the longer utterance showing no improvement. Following SF -Treatment, the increase was maintained for the two-syllable utterance while the three-syllable utterance showed a marginal increase. During LT-Treatment ,which followed SF-Treatment ,no decreases or increases were present in the two-syllable or three-syllable utterance. At the termination of LT-Treatment, a slight improvement was present in both the two- and three -syllable utterances.

4.2.3 DDK results for Subject 2

The DDK results for Subject 2 are tabulated in Table 4.12.

Table 4.12 DDK values for Subject 2 during the different stages of the study

NUMBER OF REPETITIONS IN 5 SECONDS OF SUBJECT 2 DURING THE DDK TASK														
	BL1	BL1	BL1	MEAN	LT	BL2	BL2	BL2	MEAN	SF	BL3	BL3	BL3	MEAN
Pete in 5 sec	3	2	2	2.3	2	2.5	3	3	2.8	4	4	4	4	4

peteke in 5 sec	2	1	2.5	1.8	1.5	2	2	1.5	1.8	2.5	3	2.5	3	2.8

During the baseline measurements, Subject 2 could manage more repetitions of the two-syllable than the three- syllable utterance. (Both the values were outside the normal interval) No change occurred during LT-Treatment in the two- and three-syllable utterances. Following LT-Treatment, the two syllable utterance increased slightly, with no change in the three syllable utterance repetitions. During SF-Treatment which followed LT-Treatment, the number of repetitions increased in both the two and three syllable utterances (the two syllable utterance values not within normal limits, but the three syllabic utterance within the normal range) and this increase in the three syllable utterance was maintained until the termination of SF-Treatment.

4.2.4 Discussion of DDK results

The normal controls produced the two-syllable utterance with slow, rhythmic precision and managed to sustain 6 repetitions over 5 seconds. The three syllable utterance showed varied results in that two of the controls could only manage two repetitions in a slow rhythmic fashion, while the third control obtained four repetitions, implying quicker speech rate while maintaining accuracy in production. The third control also had shorter durational measurements in utterance as well as vowel duration.

An increase in the number of repetitions of the two syllable utterance by the experimental subjects occurred during SF-Treatment across the different phases of the study. This is interesting especially in the case of Subject 2, because SF-Treatment occurred as the second treatment. Although learning may have occurred prior to SF-Treatment, it had little effect on the subject's ability to produce a certain number of repetitions. The increase was only present and maintained following SF-Treatment and not during LT-Treatment. Subject 1's two syllable repetitions increased and remained stable throughout LT-Treatment which followed SF-Treatment. Another increase occurred at the termination of all treatment in the two syllable words for Subject 1. Normal

values were not obtained at any stage of the study in the two syllable utterance repetitions.
The three syllable repetitions showed values similar to the normal range suggesting that all the children in the study were in the process of developing accurate, precise speech timing skills to perform the rapidly alternating sequence. The control subjects were only recorded once and it would have been interesting to see how their number and rate of repetitions increased throughout a certain time period.

The syllable production of the experimental subjects could be characterised by false starts and restarts with no attempts to self correct. They also seemed to start off too rapidly and then slow down during the repetitions to an abnormally slow rate. In contrast, the normal controls started off slowly and rhythmically. The examiner provided all the children with the same example : a slightly slow and gradually quickening pattern of the DDK syllables. The subjects also showed irregularities in pitch (low pitch or very high pitch) and in loudness (decreased loudness level). Their breathing was affected because at the end of their repetitions they seemed to be speaking on residual air. Darley, Aronson & Brown (1975) described neuromuscular properties that are required for correct speech production. They include timing, precision and the strength of contraction, the range as well as speed of movement and the accuracy of the direction of a movement. They stated that a deficit in any of these parameters will result in errors in any or all of the following components: respiration, phonation, resonance, articulation and prosody. Both the subjects could not maintain breathing for phonation for 5 seconds without reductions in loudness and pitch and according to Darley, Aronson & Brown (1975) the muscles of respiration provide inadequate breath support for the speech task at hand. Another possibility could be that Subject 1 and 2 did not adequately plan the utterance and how much breath support it would require.

Another component that was affected was articulation. Inaccurate articulations occurred as the task progressed and according to Darley et al.

(1975) the accuracy of speech movements has an effect on the strength, speed, range, direction as well as the timing of a muscular activity. Inaccuracy of speech sound production, especially when the task is demanding, may be random and hard to predict as well as having an influence on the pitch and loudness of the utterance (indicating imprecise phonatory and respiratory control).

In spite of the difficulties described above, the experimental subjects could, increase their number of repetitions with the SF-Treatment. It seemed, therefore, that the biggest contribution to the increases in DDK was not familiarisation with the task during the study, but the introduction of the SF-Treatment. According to Schmidt (1988) a salient characteristic of motor behaviour patterns is that it changes with practice and becomes more consistent, predictable and certain with experience. It would seem, therefore, that the SF-Treatment had a positive effect on the DDK of the Subjects (increased repetitions), irrespective of practice (in this case re-administration of the probe test for the duration of the study).

4.3 Description of intelligibility rating results

4.3.1 Intelligibility of the normal controls

The normal controls were regarded as highly intelligible by the panel members and their speech sample was used as the norm to which the speech samples of the experimental subjects had to be compared. On the 7 point scale, the control subjects obtained a 7 that can be regarded as completely intelligible and the experimental subjects were compared to their level of intelligibility.

4.3.2 Intelligibility of Subject 1

The intelligibility results of Subject 1 are tabulated in Table 4.13.

Table 4.13 Intelligibility results of Subject 1

THE INTELLIGIBILITY RATING OF SUBJECT 1 BY THE PANEL ON A 7 POINT SCALE													
Panel Mem bers (PM)	BL1	BL1	BL1	Ave of BL1	SF	BL2	BL2	BL2	Ave of BL2	LT	BL3	BL3	BL3	Ave of BL3
PM1	4	2	3	3	7	5	4	6	5	5	5	6	5	5
PM 2	4	2	3	3	7	5	4	6	5	5	5	5	5	5
PM 3	4	3	3	3	6	5	5	5	5	5	5	5	5	5

Subject 1 showed poor intelligibility during the pre-treatment baselines and the panel members reached general consensus with an average of 3 out of 7. During SF-Treatment, Subject 1 was regarded as just as intelligible or nearly as intelligible (Panel member 3) as the normal controls. This high level of intelligibility could not be maintained following SF-Treatment or during LT-Treatment (which followed SF-Treatment). Following LT-Treatment , Subject 1 obtained a value of 5 out of 7. It seemed that the highest intelligibility rating was obtained during SF-Treatment.

4.3.3 Intelligibility of Subject 2

The intelligibility results of Subject 2 are tabulated in Table 4.14.

Table 4.14 Intelligibility results of Subject 2

THE INTELLIGIBILITY RATING OF SUBJECT 2 BY THE PANEL ON A 7 POINT SCALE														
Panel Mem bers (PM)	BL1	BL1	BL1	Ave of BL1	LT	BL2	BL2	BL2	Ave of BL2	SF	BL3	BL3	BL3	Ave of BL3
PM1	1	3	4	3	4	3	7	6	5	6	6	4	5	5
PM 2	1	3	4	3	6	3	7	6	5	6	6	4	5	5
PM 3	2	3	4	3	5	3	7	6	5	6	6	4	5	5

Subject 2 was rated by the panel members as varying in intelligibility during the pre-treatment baselines, but all the values were below the normal controls' intelligibility. Intelligibility did increase during LT-Treatment. Following Lt-Treatment, varying values were obtained and although the mean value showed an increase from the LT-Treatment condition, the individual values ranged from poor intelligibility to completely intelligible. During SF-Treatment, Subject 2 was considered nearly as intelligible as the normal controls and at the termination of all treatment following SF-Treatment a slight decrease could be observed in intelligibility. It seemed that the highest intelligibility was obtained during SF-Treatment.

4.3.4 Discussion of Intelligibility results

Speech intelligibility is defined by Kent (1992) as the match between the intentions of a speaker and the listener's response. In this study, the effect of two treatments were compared in terms of their possible influence on intelligibility because, according to Kent (1997), intelligibility is an integral component that requires addressing when treatment outcomes are described.

Both subjects displayed poor intelligibility as rated by the panel at the onset of the study. In addition to poor overall intelligibility, they were accorded varying ratings by the panel members for each of their pre-treatment baselines. There seemed to have been increased intelligibility with the introduction of SF-Treatment in Subject 1. Subject 2 showed an increase in intelligibility with the introduction of LT-Treatment as well. Both the subjects could maintain the intelligibility with the introduction of the alternate treatment as they obtained average values that remained stable when compared to the averages before the treatments were switched. There seemed to have been no specific treatment that enhanced intelligibility more than its counterpart in either of the subjects.

Intelligibility is influenced by an inexhaustive list of variables. An intelligibility rating is merely a perceptual judgement on the part of the listener (Moll, 1963). When looking at an overview of some of the results of each subject there are many aspects that may influence their intelligibility. They displayed misarticulation of the [r] sound in single sounds and sound combinations in a word, resulting in omission of the [r] in words that in turn affected the type of syllable structures used in their spontaneous speech. On a single word level, the subjects showed duration inconsistency and the DDK results indicated that they exhibited inaccurate and distorted production of the syllables.

Intelligibility increased irrespective of order of treatment. This phenomenon could possibly be ascribed to the subjects attending to the examiner's correct model and developing increased awareness of accurate articulation and, therefore, increasing their intelligibility.

4.4 Description of phonological process analysis results

4.4.1 Phonological process analysis for the normal controls

There were no phonological processes present in any of the controls' spontaneous speech. No single sounds in the initial, medial or final position in words, or sound combinations were simplified, omitted, substituted or distorted in any manner or place of articulation.

4.4.2 Phonological process analysis of Subject 1

No abnormal phonological processes were present in the spontaneous speech of Subject 1 during any of the different stages of the study. During the different stages of the study, irrespective of type of treatment, cluster reduction occurred within words that contained the [r] in the cluster. The [r] was omitted in the cluster.

Concerning single sounds, the [r] sound was deleted in the word final position in words containing the [r] in the word final position. The [r] was substituted for [l] in the word initial position as a single sound in words. Therefore cluster reduction, sound omission and sound substitution occurred and they are mentioned as they had a direct effect on the type of syllable structures that were most frequently used by Subject 1. Subject 1 did, however, obtain the [r] sound in the word medial position during the second of the last baselines before the termination of treatment.

4.4.3 Phonological process analysis of Subject 2

Subject 2 simplified words containing the [r] sound. Cluster reduction occurred with clusters containing the [r] sound. The [r] sound was omitted from the cluster. The [r] in word initial position was substituted for [l] or [j] and omitted in the word final position. No other sounds were affected in the speech of Subject 2.

4.4.4. Discussion of phonological process analysis results

A phonological process analysis was included in the probe test because it contributes to the identification of patterns in the child's language and also allows the differentiation of the types of patterns as they occur consistently in the child's speech (Lund & Duchan, 1983). In this particular study, it was attempted to determine whether SF-Treatment had any effect on the phonology of the subjects as opposed to LT-Treatment. The results for both Subject 1 and 2 were inconclusive. The normal controls did not apply any strategies or general processes to reduce the adult target to a simpler form (Hodson & Paden, 1983) and although Subject 1 and 2 showed omissions of the final consonant and cluster reduction of [r] combinations, they did not exhibit phonological processes per se. According to Peterson & Marquardt (1990) a phonological process can be identified if it is stable for a number of error sounds (Subject 1 and 2 showed only one defective sound namely [r]) and that the process should occur with a frequency that allows the examiner to feel confident that the process is present. Neither Subject 1 nor 2 fit the criteria.

Phonology, furthermore, implies that, according to McReynolds & Elbers (1981a), an underlying error pattern exists which resulted in the acquisition of an inappropriate and deviant phonological rule. In the case of both Subject 1 and 2, the mispronounciation of the [r] could rather be a simple articulation error that manifests itself on the level of motor response that is on a surface level rather than on the level of underlying linguistic rule structures (McReynolds & Elbers, 1981a).The authors described some children's inability to produce certain segments of a word, and specifically a sound, because they lack the motor skill to combine the place and manner characteristics of a particular sound. Subject 1 and 2 had the place of articulation correct, but were unable to correct their manner of articulation which, according to Abbs and Kennedy (1982) constitute delayed development in sensorimotor control. This delay restricts the child's ability to learn the intended reactions required to execute certain sounds consistently.

Neither SF-Treatment nor LT-treatment showed any effect on the subjects' misarticulation of the [r] up to the second last baseline of the study when Subject 1 suddenly acquired the [r] in the medial position in words. According to Hoffman, Schuckers & Daniloff (1980) and Stephens, Hoffman and Daniloff (1986) studies of individual children's development showed that large gains in percentage-correct articulation of [s] and [r] can be made in as short a period as two weeks. The child's ability to learn the correct motor pattern of certain sounds is facilitated by SF-treatment, but it seemed to have no effect on the speech of the subjects. One possible explanation could be that the [r] was not targeted during treatment. The [r] was not targeted because of its difficulty of production and a normative study indicated that Afrikaans-speaking children only mastered its production by age 7 to 8 years (Lotter, 1974).

Yet, despite the fact that the subjects only misarticulated one speech sound, namely the [r], and they did not exhibit any phonological processes, their speech was highly unintelligible at the onset of the study (please see intelligibility results). The syllable structures that were present will be discussed in terms of their occurrence during the different stages of the study.

4.5 Description and discussion of syllable structure results

4.5.1 Syllable structures of the normal controls

The actual syllable structures that were produced by the controls as observed in the total number of analysed words in the spontaneous speech sample are tabulated in Table 4.15.

Table 4.15 The syllable structures of the normal controls

THE SYLLABLE STRUCTURES PRESENT IN THE SPONTANEOUS SPEECH SAMPLE OF THE CONTROL SUBJECTS AS PERCENTAGES OF THE TOTAL SPEECH SAMPLE			
Structure	Control 1	Control 2	Control 3
	%	%	%
CV	15	15	19
VC	13	8	12
CVC	31	35	33
VCV	3	2	0
CVCV	3	4	5
VCVC	0	0	0
CVCVC	3	8	0
LONGER / OTHER THAN CVCVC	33	31	31
TOTAL	100	100	100

The percentages were obtained from the speech samples of all the participants by selecting the 20 most representative utterances and determining the syllable structures of each of the words in each utterance. The syllable structures were then categorised into the different categories above and the total number of syllable structures were calculated. For each category, the percentage that the category represented of the total number of analyzed words was calculated. Control 1 had the highest percentage of syllable structures falling into the OTHER category, followed by the CVC category. The third most represented category was CV, but with a much lower percentage than the previous two categories. Control 2 and 3 had the most syllable structures in the CVC category, followed closely by the OTHER category. The OTHER category represented words that did not fall into single consonant, single vowel categories namely syllable structures such as CCV, VCVV. It also represented longer words that were transcribed as CVCVCV or CVCVCVC. The third most represented category was, as for Control 1, the CV category and it also was at a lower percentage than the previous two categories.

4.5.2 Syllable structures of Subject 1

The produced syllable structures of Subject 1 during the spontaneous speech sample of each probe test are depicted in Table 4.16

Table 4.16 The Syllable structures of Subject 1 during the different stages of the study

THE SYLLABLE STRUCTURES PRESENT IN THE SPONTANEOUS SPEECH SAMPLE OF SUBJECT 1 AS PERCENTAGES IN THE TOTAL SPEECH SAMPLE														
	BL1	BL1	BL1	AVE	SF	BL2	BL2	BL2	AVE	LT	BL3	BL3	BL3	AVE
	%	%	%	%	%	%	%	%	%	%	%	%	%	%
CV	25	16	25	22	28	28	19	20	22	24	19	13	16	16
VC	4	4	11	6	4	8	11	13	11	7	6	10	5	7
CVC	33	20	39	31	32	21	34	29	28	27	36	33	34	34
VCV	0	0	0	0	0	3	0	0	1	2	0	3	0	1
CVCV	8	12	7	9	8	5	6	13	8	7	11	13	3	9
VCVC	0	0	0	0	8	0	2	0	1	0	3	0	0	1
CVCVC	4	4	0	3	0	0	2	4	2	7	0	3	8	4
Other/longer than CVCVC	25	44	15	28	20	28	28	20	25	24	28	27	34	30
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

The most represented category for Subject 1 during the different probe tests, was , with three exceptions, the CVC category. Only in one instance, during the first baseline, in the second baseline in one instance, and in the third baseline in one instance another category namely OTHER was the most utilised. The second most frequently used syllable structure seemed to be CV, followed by the OTHER category.

4.5.3 <u>Syllable structures of Subject 2</u>

The syllable structures observed in the spontaneous speech sample of the probe test for Subject 2 are tabulated in Table 4.17.

Table 4.17 The Syllable structures of Subject 2 during the different stages of the study

THE SYLLABLE STRUCTURES PRESENT IN THE SPONTANEOUS SPEECH SAMPLE OFSUBJECT 2 AS PERCENTAGES IN THE TOTAL SPEECH SAMPLE														
	BL1	BL1	BL1	AVE	LT	BL2	BL2	BL2	AVE	SF	BL3	BL3	BL3	AVE
	%	%	%	%	%	%	%	%	%	%	%	%	%	%
CV	26	25	26	26	13	17	21	22	20	26	17	21	21	20
VC	4	7	7	6	17	11	10	11	11	11	11	5	12	9
CVC	35	29	33	32	23	32	36	33	34	34	37	15	35	29
VCV	4	4	0	3	0	0	3	2	2	0	3	0	0	1
CVCV	9	11	4	8	7	17	13	13	14	11	9	10	9	9
VCVC	0	0	0	0	7	0	3	0	1	0	3	0	0	1
CVCVC	0	0	4	1	3	6	13	0	6	0	6	0	3	3
Other/ longer than CVCVC	22	25	26	24	30	17	3	20	13	17	26	38	21	28
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

The most represented category for Subject 2 was , with two exceptions, the CVC category. Only during LT-Treatment and in the third baseline in one instance another category (OTHER) were the most utilised. The was no clear indication of which particular category was the second most frequently used as it varied throughout the different stages of the study. It seemed to be the CV and OTHER categories that were most represented and the remaining categories such as the CVCVC, VCVC , VC, VCV had marginal representation.

The syllable structure results and the phonological process analysis will be discussed together as they are closely related to each other.

4.5.4 Discussion of syllable structure analysis results

The syllable structure analysis showed that neither treatment had any effect on syllable structure and that CVC was the most frequently used syllable structure for the duration of the study in the speech of both experimental subjects. It seemed that the subjects had normal phonetic patterns for their age, as well as a range of syllable structures in their speech. Intelligibility, however, remained poor. A possible explanation may be found in the hypothesis that syllabic integrity is more critical to intelligibility than phonetic integrity. Faircloth & Faircloth (1973) found that speakers who managed to approximate the correct number of syllables during the production of a multisyllabic word were rated as more intelligible than those who distorted syllables even though individual phonemes were articulated accurately. The probe tests indicated that misarticulation of the [r] occurred. The [r] error pattern resulted in cluster reduction as well as sound deletion and according to Lund & Duchan (1983) this would involve the syllable structure of words rather than merely the phonemes. According to the data the [r] cluster reductions and the [r] omissions in particularly the final position in words, had a direct effect on the type of syllable structures used, namely CVC. The argument that syllable integrity combined with stress, intonation and rhythm affect intelligibility (Faircloth & Faircloth, 1973) may again add to the explanation of the subjects perceptually sounding less intelligible than some of the probe test results indicate.

Despite the fact that the CVCV syllable structure was targeted during SF-Treatment, its occurrence did not increase with the introduction of SF-Treatment, nor did its introduction into treatment at a regular basis decrease use of other syllable structures like CVC and CCVCC. Lund & Duchan (1983) state that children's speech samples at a certain developmental stage may exhibit a specific C-V pattern resulting in words being changed to open syllable endings like CVCV. This phenomenon was not observed in either subject and syllable structures that contained [r] were the only ones that were affected.

4.6 Description of Type-Token-Ratio (TTR) results

4.6.1 Type-Token-Ratio results for the normal controls

The TTR is calculated by dividing the total number of words by the total number of different word types in the speech sample (Shipley & McAfee, 1994). Control 1 obtained a TTR of 0.549, Control 2 of 0.573 and Control 3 of 0.517. The range of TTR is therefore between 0.517 and 0.573.

The total number of words used by the normal controls were 71, 89 and 87 respectively with a range of 71 to 89. The total number of different word types used by the normal controls were 39, 51 and 45 respectively with a range of 39 to 51.

4.6.2 Type-Token-Ratio results for Subject 1

The TTR for Subject 1 is displayed in Figure 4.5.

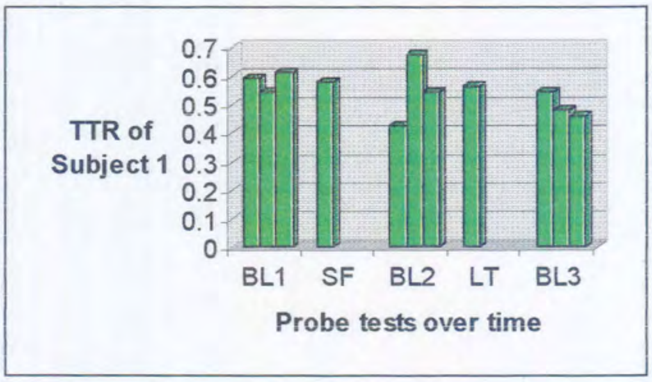

Figure 4.5 TTR of Subject 1

There was variation across the probe tests with no clear trends. The baseline TTR varies between 0.543 and 0.617. During SF-Treatment no major ratio increases or decreases were observed. Three very varied values were obtained in the following SF-Treatment phase because both the highest and the lowest

TTR values were obtained during this period. The during LT-Treatment phase of the study, showed a TTR value similar to the values obtained in the pre-treatment baselines and the SF-Treatment phase. The TTR lowered at the termination of all treatment. Only four TTR values of Subject 1 were outside of the normal range.

Two of the three pre-treatment baseline ratios were at a higher value than the range of the normal controls. Following SF-Treatment, one of the baselines were at a lower value than the normal range and one at a higher value than the normal range.

As the TTR is calculated from the total number of words and the total number of different words in the speech sample, these two aspects were also examined separately. The total number of words during the stages of the study is presented in Figure 4.6

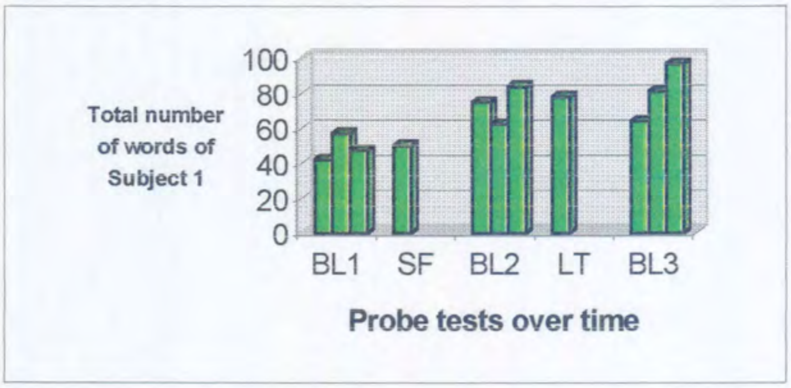

Figure 4.6 The total number of words of Subject 1 in the TTR

There was a gradual increase in the total number of words used in each probe test. At the onset of the study a total of 42 words were counted which was well below the normal range of 71 to 89. At the termination of all treatment, 97 words were counted which was well above the normal range. SF-Treatment did not increase the total number of words, but following SF-Treatment there was an increase. The increase could be maintained during the LT-Treatment and although there was a slight decrease during the first of the last three baselines following LT-Treatment, the total number of words increased steadily in the remaining two of the baselines following LT-Treatment.

The total number of different word types are displayed in Figure 4.7 for Subject 1

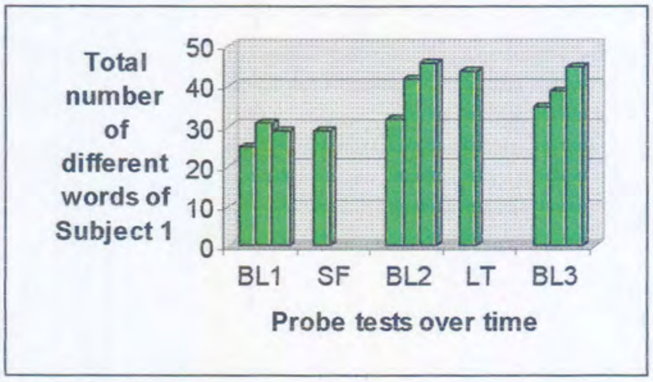

Figure 4.7 Total Number of different word types in the TTR for Subject 1

The number of different word types were below the normal range at the pre-treatment level with no change during SF-Treatment. Following SF-Treatment, the number of different words increased within the normal range and this level was maintained during the LT-Treatment phase until the termination of treatment following LT-Treatment.

4.6.3 Type-Token-Ratio results for Subject 2

The TTR values of Subject 2 are graphically displayed in Figure 4.8

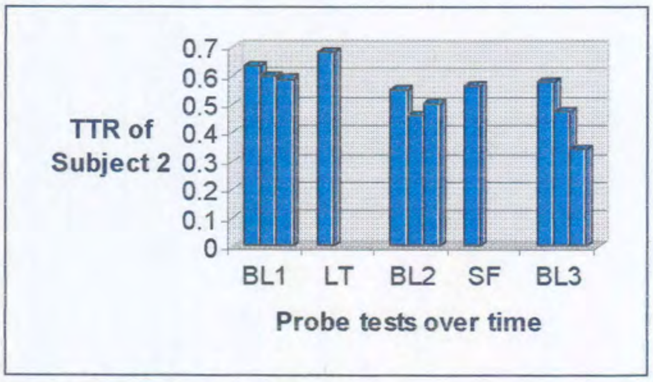

Figure 4.8 TTR for Subject 2

The pre-treatment values were higher than those for the normal controls and increased during the LT-Treatment condition. TTR decreased following LT-

Treatment. Increases occurred during SF-Treatment, but not to pre-treatment, or During LT-Treatment levels. A slight increase in the first of the 3 baselines following SF-Treatment was observed but could not be maintained for the two remaining baselines of the following SF-Treatment condition. The first four measurements were at higher values than the normal controls' range of TTR. Following LT-Treatment, two of the three baselines were at lower values than the normal values. Following SF-Treatment one value was lower and two values were higher than the values for the normal controls.

When the total number of words is examined, certain trends can be identified. The results are displayed in Figure 4.9 for Subject 2.

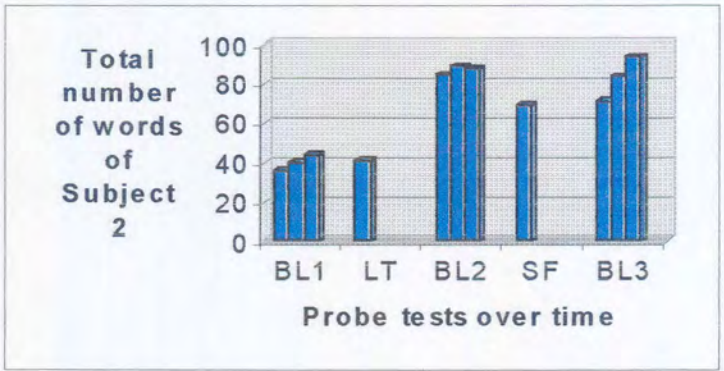

Figure 4.9 The total number of words of Subject 2 in the TTR

The baseline for the total number of words remained stable and showed no change during LT-Treatment. Following LT-Treatment the total number of words increased dramatically but could not be maintained during SF-Treatment. The total number of words increased following SF-Treatment and reached the highest level at the termination of all treatment following SF-Treatment.

The total number of different word types for Subject 2 are displayed in Figure 4.10.

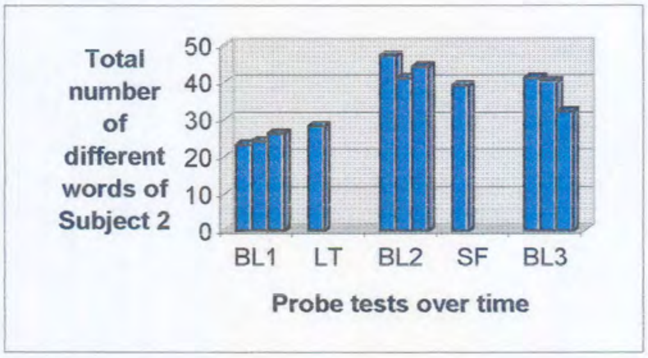

Figure 4.10 Total Number of different word types in the TTR for Subject 2

Subject 2 obtained lower than normal scores with the total number of different words. A slight increase occurred during LT-Treatment and following LT-Treatment the values increased to within the normal range. There was a slight decrease during SF-Treatment, yet still within the normal range. Following SF-Treatment the number of different word types decreased until the termination of treatment.

4.6.4 Discussion of Type-Token-Ratio results

According to Shipley & McAfee (1992) the TTR is a simple measure of a subject's functional vocabulary and by means of a ratio the examiner is able to determine the diversity of words that is used by the particular subject. A substandard TTR could be an indication of an expressive language delay.

The TTR of Subject 1 did not show clear progress during any of the treatment stages and most of the values fell within normal limits. A gradual increase in both the total number of words and the total number of different word types could be observed during the study. This increase may be due to development or to the regular intervention that had been received by Subject 1 and not due to any type of treatment in particular.

Subject 2 showed more TTR ratios out of the normal range, mostly higher than the normal range irrespective of the time and type of treatment that was received. The total number of words and the total number of different word types increased gradually until all treatment was terminated and no dramatic increase could be observed at a specific stage of the study. This change could possibly be ascribed to intervention and not a particular treatment per se.

A higher than normal TTR score may reflect the over-reliance on words that have a wider applicational value without a specified meaning such as " thing". Children who have a poor vocabulary would incorporate unspecified words into their speech due to the more specified words not being at their disposal. It seems that Subject 2 benefitted from intervention in general and not from a specific treatment in particular, hence the progressively better TTR scores.

4.7. Description of Mean-Length-of-Utterance (MLU) results

4.7.1 MLU of the normal controls

The MLU of the normal controls are displayed in Figure 4.11

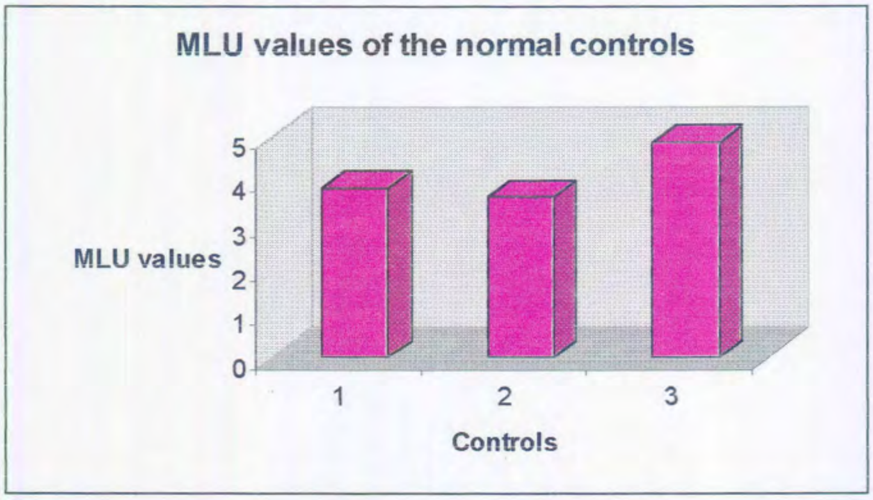

Figure 4.11 The MLU values of the normal controls

The MLU of the normal controls were 3.619, 4.850 and 3.833 for Control 1,2, and 3 respectively. The range of MLU for the normal subjects were 3.619 to 4.850.

4.7.2 MLU of Subject 1

The MLU results for Subject 1 are displayed in Figure 4.12

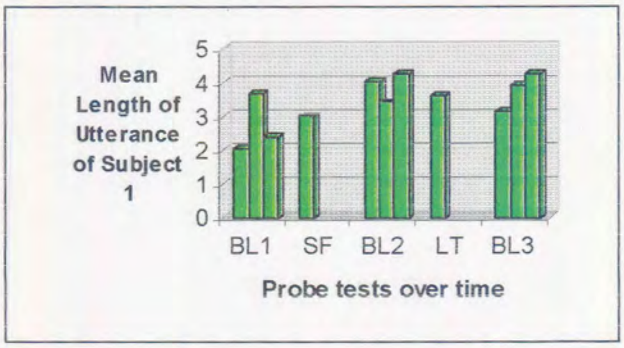

Figure 4.12 MLU of Subject 1 during the different stages of the study

The pre-treatment baselines varied considerably and during SF-Treatment no significant increase or decrease occurred. Following SF-Treatment the MLU increased to within the normal range. The increase could not be maintained and MLU decreased slightly during LT-Treatment. Following LT-Treatment the baseline varied again but increased to reach the same levels as following SF-Treatment.

4.7.3 MLU of Subject 2

The MLU results of Subject 2 are displayed in Figure 4.13.

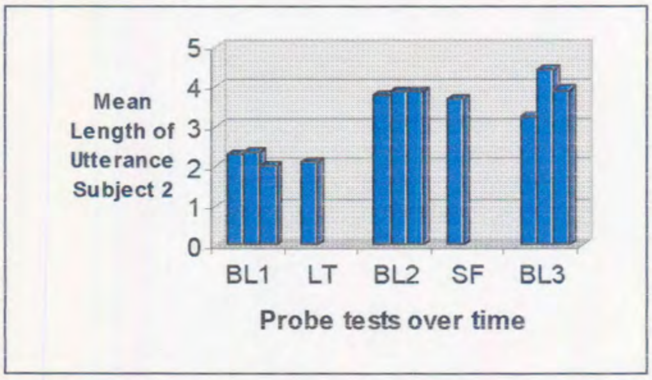

Figure 4.13 MLU of Subject 2 during the different stages of the study

The pre-treatment baseline remained stable for Subject 2 and showed very little change during LT-Treatment. Following LT-Treatment showed increased MLU values to within the normal range and these values were maintained during SF-Treatment. Following SF-Treatment, the baselines varies but showed an increase at the termination of treatment.

4.7.4 Discussion of MLU results

MLU is the average length in morphemes of a speaker's utterance and gives an index of linguistic maturity (Owens, 1991; Van Riper & Emerick, 1990). In this study, the MLU of Subject 1 varied from probe to probe, but showed a steady upward curve despite the fluctuations in MLU values. The MLU of Subject 2 showed a dramatic increase following LT-Treatment and then stabilised at that level.

Brown (1973) found that, as a child's MLU increases, the process of incorporating more complex structures into his sentences occurs. New structures added to the child's utterances, therefore, increase the complexity of the sentences and also the MLU value. In the case of Subject 1, no particular treatment caused a dramatic increase or decrease in MLU values. In Subject 2's case, the MLU seemed to increase following LT-Treatment but that SF-Treatment (which followed LT-Treatment).Treatment outcome on MLU is the case of Subject 2 is , therefore, inconclusive.

Brown (1973) described stages of syntactic development based on MLU values and concluded that a normal child's chronological age is closely linked to his/her MLU obtained until the age of 5. At this level of development, much of the added complexity in a child's utterance is due to internal re-organisation of an utterance form rather than the addition of new structures. The normal controls in this study rated as Stage III (2,11 - 3,4 years), Stage V+ (3,11 -older years) and Stage V (3.5 - 3.10 years) of the Brown stages respectively, indicating normal or above normal MLU values.

Miller & Chapman (1981) established age norms for MLU of conversational speech samples using 123 children. Compared to these norms, control 1 ,2 and 3 fell within the normal range, or in Control 2's case, above the normal range.

Experimental subject 1 proved difficult to categorize according to the stages described by Brown (1973). During SF-Treatment subject 1 tested at 3 years 0 months which was slightly below age and the same value was obtained during LT-Treatment. When compared to the MLU results of the Miller & Chapman (1981) study, Subject 1 also performed at the 3 yrs o months level. Subject 2 tested below the norm when measured to the Brown stages during LT-Treatment. Following LT-Treatment, Subject 2 tested above the norm according to Brownian stages (1973). During SF-Treatment (which occurred second) MLU scores were within the norm and following SF-Treatment above the norm. Comparison to the Miller & Chapman data once again confirmed the level of performance. It seems, then, that both the subjects are in the process of syntactic development according to their variations in MLU with the specific treatments not having any particular effect.

4.8 Description of the pragmatic screening results

4.8.1 Pragmatic screening results for the normal controls

The pragmatic screening consisted of seven aspects of pragmatics that were indicated as present or absent in the subjects' spontaneous speech samples. The behaviours were not elicited in any way, but instead the experimenter merely observed whether any of them occurred when appropriate in the communication situation. The seven aspects were: requesting, taking turns, following commands, attendance to tasks, maintaining a topic, understanding object function and initiating of activity or dialogue (Shipley & McAfee, 1992). Either verbal or non-verbal indications of the seven aspects were accepted in each instance. The normal controls displayed all of the listed aspects occurring during the spontaneous speech sample.

4.8.2 Pragmatic screening results for Subject 1

The pragmatic screening results of Subject 1 are tabulated in Table 4.18.

Table 4.18 Pragmatic screening results for Subject 1

THE ABSENCE (-) AND PRESENCE (YES) OF CERTAIN ASPECTS OF PRAGMATIC LANGUAGE USE IN THE SPONTANEOUS SPEECH SAMPLE OF SUBJECT 1											
Aspects	BL1	BL1	BL1	SF	BL2	BL2	BL2	LT	BL3	BL3	BL3
Makes requests	1 occurrence	1 occurrence	2 occurrences	Yes	-	-	-	yes	yes	yes	yes
Takes turns	Yes	yes	yes	Yes	Yes	Yes	Yes	yes	yes	yes	yes
Follows commands	-	-	-	-	-	Yes	Yes	yes	yes	yes	yes
Attends to tasks	Yes	yes	yes	Yes	Yes	Yes	yes	yes	yes	yes	yes
Maintains topic	Yes	yes	yes	Yes	Yes	Yes	yes	yes	yes	yes	yes
Understands object function	-	-	-	Yes	-	-	-	yes	yes	-	-
Initiate activity or dialogue	Yes	yes	yes	Yes	Yes	Yes	yes	yes	yes	yes	yes

The following aspects were present in Subject 1's spontaneous speech sample throughout the study: turn taking, attendance to tasks and initiation of activity or dialogue. Requesting occurred during the LT-Treatment and following LT-Treatment but was absent in the preceding SF-Treatment. Subject 1 was unable to follow commands during pre-treatment recordings and during SF-Treatment. Following SF-Treatment this behaviour started occurring consistently. Subject 1's understanding of object function varied during the different stages of the study and that seemed to be the only aspect of this pragmatic screening not be consistently present during the study.

4.8.3 Pragmatic screening results for Subject 2

The pragmatic screening results for Subject 2 are tabulated in Table 4.19.

Table 4.19 Pragmatic screening results of Subject 2

THE ABSENCE AND PRESENCE OF CERTAIN ASPECTS OF PRAGMATIC LANGUAGE USE IN THE SPONTANEOUS SPEECH SAMPLE OF SUBJECT 2										
Aspects	BL1	BL1	BL1	LT	BL2	BL2	BL2	SF	BL3	BL3	BL3
Makes requests	-	-	-	-	-	Yes	yes	yes	yes	yes	yes
Takes turns	Yes	yes	yes	yes	Yes	Yes	yes	yes	yes	yes	yes
Follows commands	-	-	-	-	Yes	Yes	yes	yes	yes	yes	yes
Attends to tasks	-	yes	yes	yes	Yes	Yes	yes	yes	yes	yes	yes
Maintains topic	-	-	-	yes	Yes	Yes	yes	yes	yes	yes	yes
Understands object function	-	-	-	-	-	-	yes	yes	yes	yes	yes
Initiate activity or dialogue	Yes	yes	yes	yes	Yes	Yes	yes	yes	yes	yes	yes

The following pragmatic aspects were present from the onset of the study: turn taking and the initiation of activities and dialogue. Requesting , following commands and topic maintenance were present following LT-Treatment. The functions of objects was the only aspect in the pragmatic screening that was not consistently present during the different stages of the study.

4.8.4 Discussion of pragmatic screening results

Pragmatics integrates and synthesises the components of language namely the form, function and content. In its broadest sense, it focuses not only on the producer of the utterance but also on the receiver. Pragmatics, therefore, has to do with intentions, maintenance of a conversation, awareness of another participant in a communication situation and the ability to communicate with others (Smith & Leinonen, 1992; van Riper & Emerick, 1990). It has to do with language as a social tool. Smith and Leinonen (1992) caution clinicians that overemphasis on the structures of speech and language without a meaningful context often affect treatment outcomes negatively because structure acquisition and knowledge do not ensure structure use during spontaneous interaction. They describe the interactive nature of the various components of language, pointing out that improvements in pragmatic skills often lead to improved phonological and syntactic performance and that an enlarging vocabulary may lead to better pragmatic performance through the growth of confidence.

Brinton & Fujiki (1999) also state that pragmatics examines language as a social tool. According to Brinton, Fujiki and Sonnenberg (1988) children with speech and language delay have shown that they are less adept in the social manipulation of language (such as the repair of a communication breakdown following a request for clarification) than their normally developing counterparts. In this study two treatments were compared in terms of their effectiveness to treat a marked, general speech and language delay. The pragmatic screening checklist was included to ensure that the social nature of language as it occurs during spontaneous interaction is addressed albeit in a very superficial manner. The pragmatic screening checklist (based on Shipley & McAffee,1992) was used in this study in an attempt to alert the researcher to possible areas of concern that occur during the two treatment phases of the study and to determine whether any of the two treatments had a facilitating or detrimental effect on the selected aspects of the screening test.

The checklist is far from comprehensive and was not employed as an instrument to probe causes for certain behaviours. It merely attempted to alert the researcher to the conversational abilities of a client, and in this case, to observe if any of the treatments had a positive or negative effect on pragmatics.

Subject 1 and 2 showed appropriate pragmatic behaviour for their age, along with the normal controls. In the case of Subject 1, some of the behaviours that were part of the pragmatic screening checklist were present from the onset of the study. The screening checklist showed that Subject 1 had difficulty with requesting, but this behaviour emerged during LT-Treatment. Subject 1 also experienced difficulty with the following of commands, but this behaviour occurred following SF-Treatment. The only aspect that was not consistently present at the termination of treatment was the understanding of object function. This behaviour is closely related to vocabulary skills. The general speech and language delay of Subject 1 contributed to the lack of understanding of object function and inconsistent performance in this aspect. The material was varied at each probe test and unfamiliarity with the material also could have played a role.

Neither SF-Treatment nor LT-Treatment seemed to have a more pronounced effect on the aspects that weren't present at the onset of the study. It seemed that pragmatic development occurred in conjunction with development in some other aspects of language development, such as Mean-Length of Utterance and Type-Token-Ratio results.

Subject 2 also showed difficulty with requesting and following commands, but these two behaviours were emerging during and following LT-Treatment. Understanding of object function did not occur consistently at the termination of treatment and this could be related to poor vocabulary skills. It is not clear whether it was LT-Treatment specifically, or the intervention per se that facilitated development of some of the pragmatic aspects in the screening checklist.

The inconclusiveness of these results are further aggravated by the fact that there are no normative data available on early pragmatic development and secondly that the material had to be varied at each session due to the nature of the examination. The variation of the material is essential in any pragmatic evaluation as it forces the subject to vary communication according to the situation and allows the researcher to determine what the subject is able to accomplish during the interaction without formal prompts (Shipley & McAfee, 1992).

Unfortunately the fluid nature of the communication situation has an adverse effect on the tracking of treatment outcomes for the two treatments because it leaves many questions unanswered. For instance, it was difficult to determine whether the absence of a specific behaviour was caused by unfamiliarity of the subject with the material, by the treatment itself or by a combination of the effect of the subject's speech and language delay, the material used as well as the treatment that was administered at that point in the study.

All that could be gathered from the pragmatic checklist is that pragmatic development occurred during the progression of the study. The relative contribution to pragmatic development of each of the two treatments are unclear but no adverse effect and regression of language use and pragmatics occurred at any stage of the study for either of the subjects.

4.9 Summary of Chapter 4.

The results of the probe tests that were conducted over time during the experimental phase of the study were discussed for each subject, as well as compared to the values obtained for the three normal controls. Following the description of the results of each aspect of the probe test, a discussion of the findings for that particular aspect was presented.

Chapter 5

Conclusion

5.1 Introduction

In this Chapter, the results will be briefly summarized. The results will be discussed as an integrated whole and related to the aims and objectives of the study as described in Chapter 3. Conclusions will be discussed.

5.2 SUMMARY OF RESULTS

The study consisted of two major components namely the compilation of a Speech Facilitation Program(SFP) and following that, the clinical application of the treatment program within an alternating treatment design study using speech facilitation and language therapy respectively. During the treatment phase of the study, probe tests, consisting of 10 selected aspects of speech and language, were conducted to determine the effect of the two treatment approaches on these aspects. For Subject 1, treatment with the speech facilitation program was conducted as first treatment (SF-Treatment). In Subject 2's case, treatment with language therapy (LT-Treatment) was conducted first. After an equal number of sessions, the two treatments were alternated.

The effect of the two treatments on the two subjects' performance varied and will be summarized briefly in Tables 5.1,5.2 and 5.3.

Table 5.1 Aspects that showed improvement following treatment.

ASPECT	TREATMENT	SUBJECT	OBSERVATION
Vowel and Utterance Duration	SF-Treatment	1	The nearest approximations to normal values could be observed following SF-Treatment. A large decrease in Vowel and Utterance Duration occurred in Subject 1 when SF-Treatment was withdrawn , in other words before the

			commencement of LT-Treatment.
DDK of the two-syllable utterance	SF-Treatment	1 and 2	An increase in the number of repetitions of the two-syllable utterance could be observed during SF-Treatment in both subjects. The fact that Subject 2 received SF-Treatment as second treatment seems to indicate that it was the treatment itself and not just regular intervention that facilitated the increase in number of repetitions. The subjects could increase their repetitions without reducing the accuracy of their productions. The DDK results, therefore, suggest that accurate production, articulation and increased repetition rate were facilitated during SF-Treatment when compared to LT-Treatment irrespective of the time of administration and therefore experimental control was demonstrated for DDK.

Table 5.2 Aspects that showed gradual development irrespective of the type of treatment.

ASPECT	TREATMENT	SUBJECT	OBSERVATION
Intelligibility rating	SF-Treatment and LT-Treatment	1 and 2	Intelligibility increased irrespective of order of treatment. It could possibly be ascribed to the subjects attending to the examiner's correct model and developing increased awareness of accurate articulation and, therefore, increasing their intelligibility.
Mean-Length-of-Utterance (MLU)	As above	2	Subject 2 showed a gradual increase in MLU values during the phases of the study commencing from below normal scores to above normal scores. It seems that intervention, irrespective of the nature of the

			approach used, had a positive influence on MLU.
Type-Token-Ratio (TTR)	As above	1 and 2	The TTR results showed a gradual increase in the total number of words and the total number of different words during the study which could possibly be ascribed to regular intervention that had been received by Subject 1 and 2 and not the type of treatment per se.
Pragmatic Screening	As above	1 and 2	It seemed that pragmatic development occurred in conjunction with development in some other aspects of language development namely language form (MLU), language content (TTR) and language use (pragmatic screening).

Table 5.3 Aspects that showed no change during the respective treatments.

ASPECT	TREATMENT	SUBJECT	OBSERVATION
Voice Onset Time (VOT)	SF-Treatment and LT-Treatment	1 and 2	VOT remained normal throughout the duration of the study.
Vowel duration and Utterance Duration	As above	2	Subject 2 showed shorter than normal VD and UD measurements irrespective of the type of treatment.
DDK three- syllable utterance	As above	1 and 2	The three- syllable repetitions showed similar values for all participants in the study suggesting that the subjects and the normal controls were in the process of developing accurate, precise speech timing skills to form the rapidly alternating longer sequence.
Syllable structure	As above	1 and 2	Neither of the treatments had any effect on syllable structure during the stages of the study, as the CVC syllable structure was the

			most frequently used for the duration of the study.
Phonological analysis	As above	1 and 2	When the phonology of each subject was analyzed, neither of the subjects exhibited processes in their speech but merely misarticulation of the [r] in all positions in words and in all sound combinations. Neither SF-Treatment nor LT-Treatment showed any effect on the subjects' misarticulation of the [r] up to the second last baseline of the study when Subject 1 acquired the [r] in the medial position in words. The misarticulation of the [r] was not a point of concern during the study as phonology literature clearly indicates that the correct articulation of the [r] is only acquired at a later stage and the [r] was also not targeted in the SFP.
Mean Length Of Utterance (MLU)	As above	1	Subject 1 showed similar MLU measurements during SF-Treatment and LT-Treatment indicating that neither treatment had any effect on MLU.

5.3 Evaluation of research methods

5.3.1 Evaluation in terms of the aims of the study

The first aim was the development of the Speech Facilitation Program as an extension of the SMLP (Van der Merwe, 1985). The selection of the sounds (consonants and vowels) according to developmental sequence proved to be difficult as there were varying reports in the literature, but a representative order was selected based on the majority of literature findings. The format of the original and long-term stages of the original program provided structure to the

SFP and it provided the researcher with guidelines to compile a comprehensive treatment program.

Treatment with the SFP proved to have inherent difficulties in its instructions and requirements. Because of the strict production criteria that had to be adhered to at every stage of the program, the treatment remained intensive and focused. On the other hand, because of the receptive abilities of the subjects, it proved to take considerable time to establish the demand for consistent, accurate production during each session , as well as getting the subjects to repeat 5 productions sequentially. Their initial incomprehension of the consistency demand caused the initial session content to be reduced considerably. As their familiarity with the expectations increased, so did the content of each session.

Another aspect of concern was the monotony of the sessions. Although care was taken to use interesting material to engage the subjects, the basis of the program is drill work and repetition. Therefore, a theme-based or story context should be provided to establish some form of intentional communication context to the SFP. It will, furthermore, assist in the generalization of the core vocabulary and phrases into everyday language.

5.3.2 Evaluation in terms of the research design

An alternating treatment design was selected for the study to determine the relative effectiveness of two treatments on certain aspects of communication. The research design provided the researcher with a framework and a format in which two treatments could be performed simultaneously and then alternated, as well as some suggestions on how to measure performance at certain time intervals.

It is, however, a complex research design that requires considerable organization and could not be employed fully for its purpose (to determine the relative effectiveness of two treatments) because of the limited number of subjects and controls. Another concern was the influence of normal development on the results. The duration of treatment was limited in order to eliminate the influence of the gradual, steady development of the subjects. In that manner, marked changes that occurred during the treatments could be ascribed to the influence of treatment and not merely normal development. It was obvious that certain changes did occur in some of the motor parameters of speech production.

5.3.3 Evaluation of the subject selection

The subjects that were selected for the study displayed several characteristics considered to be indicators of high risk for communication delay namely multiple birth (they were members of a triplet), extreme prematurity (born at 26 weeks), nasogastric feeding (3 months) as well ventilation (2 weeks after birth) (Rossetti, 1996). They were also highly comparable as they were subjected to identical environments through life (language, familial and social-economic) and were therefore considered ideal candidates for the study. They had not received any previous speech or language intervention. According to their first nursery school teacher, they displayed infantile behavior in all areas of development (fine and gross motor, speech, language and perception) hence their suitability for inclusion in this study. In retrospect, more attention could have been paid to speech and motor skill in the selection criteria especially as one of the treatments, namely the SFP, is based on the development of speech and speech motor skill.

In both cases, however, their inadequate comprehension hampered optimal participation in the treatment sessions. It was the case in both treatments (Language and SF), but more pronounced during SF-Treatment because of the very organized and structured nature of the treatment.

Another aspect that is worth mentioning is the educational history of the subjects. They changed schools halfway through the study and care was taken by the researcher to monitor any obvious changes in behavior as a result of the transition and adaptation to a new environment. None were observed. Their parents stated that following school holidays or during or directly after the transition, no atypical behavior occurred in either subjects. The triplets remained together during the transition and this stability probably provided the subjects with security.

During treatment, the subjects enjoyed the treatment sessions and were always eager to participate. The SF-Treatment, however, could possibly have started at a later point of entry into the program eg. Stage 3 or 4, which are motorically more complex, because the subjects were able to produce all the sounds in the program. The fact that they were not as intelligible as other children of their age and that their articulation that seemed motorically immature, indicated commencement on the lowest level of the SFP. One could also argue that, due to their poor comprehension, it was more viable to start at the beginning to ensure that they are familiarized with the requirements and production criteria of the SFP. The development of an evaluation for point of entry into the program,as well as, (perhaps more importantly) specific criteria for progress are therefore, indicated.

5.3.4 Evaluation of the aspects included in the probe test

The aspects that were selected for the probe test contained most components of speech and language and therefore provided an overview of communication. It did not, however, provide any information beyond mere description. For instance, it seemed that SF-Treatment had a positive effect on duration measurements in Subject 1 and on the DDK results in both subjects but these results, when considered as part of the complete probe test, still remain inconclusive. It seems that more in-depth speech related aspects and motor related aspects would have provided the researcher with more conclusive results.

5.4 Recommendations for future research

- As an extension of this research project, it would be advisable that the program be distributed to people other than speech-language therapists. Research should then be conducted to determine whether the SFP deserves a place in the primary health care situation as a tool for health workers in the early management of early speech and language delay.

- It is also recommended that the SFP be applied to more subjects by speech-language therapists as well as other professionals like teachers to determine its value in the facilitation of early speech and language.

- Another suggestion is to use the SFP in combination with other types of therapy to determine whether SF-Treatment in conjunction with language therapy, or in combination with occupational therapy, proves beneficial.

- It is also recommended that an intentional context of communication be created for the SFP by creating a story or activity book with the target sounds and vocabulary to increase generalization into the everyday life as well as to facilitate the willingness to do drill work during each session.

- Further development of the SFP should entail the development of video or audio cassette with a few examples of how the treatment is conducted to provide individuals wanting to use the program with a correct model for treatment.

- The development of an evaluation form as well as criteria for progression to a next level are also recommended to determine at which Stage and/or variation level treatment should commence or progress to.

- Application of the SFP in populations with more pronounced delays in speech development as well as implementation in specific populations for example children with Down Syndrome could provide information on specific aspects of motor development.

- Lastly, the inclusion of later stages to the SFP, that could target specific languages such as Afrikaans, Sepedi , Zulu and English would provide older children, with additional treatment options, following treatment with the SFP .

In essence, this study was a pilot study in the treatment of early speech delay from a motor perspective where the emphasis is placed on the facilitation of speech production. The current author is of the opinion that the study proved that such a treatment option would be beneficial and valuable. Not only will it provide speech-language therapists with an additional tool in the treatment of particular disorders of speech production, but its validity could possibly extend into the primary health care sector with all its role players (health care workers, professionals from different fields and even volunteers). Further research is clearly indicated in this regard.

5.5 Summary of Chapter 5

The results of the study were summarized. Conclusions were drawn in terms of the effectiveness of the treatment approaches and the validity of the SFP as a treatment tool for speech and language delay in the early years. Recommendatiosn for future research were also discussed.

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Appendix A

An excerpt form the Speech Facilitation Program[1]

STAGE 1

Target Consonants: / b d m /

Target Vowels: / a ɛ i u/

Syllable Structure: CVCV

Level 1	**C1 V1 C1 V+**		
baba	bubu	bibi	bɛbɛ
babu	bubi	bibu	bɛbu
babi	bubɛ	bibɛ	bɛbi
babɛ	buba	biba	bɛba
dada	dudu	didi	dɛdɛ
dadu	dudi	didu	dɛdu
dadi	dudɛ	didɛ	dɛdi
dadɛ	duda	dida	dɛda
mama	mumu	mimi	mɛmɛ
mamu	mumi	mimu	mɛmu
mami	mumɛ	mimɛ	mɛmi
mamɛ	muma	mima	mɛma

Level 2	**C1 V1 K2 V+**		
bada	budu	bidi	bɛdɛ
badi	budi	bidɛ	bɛdi
badu	budɛ	bidu	bɛdu
badɛ	buda	bida	bɛda
bama	bumu	bimi	bɛmɛ
bami	bumi	bimɛ	bɛmi

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[1] The complete SFP is not included as an Appendix as it is copyrighted by the University of Pretoria. Enquiries about the Complete SFP can be directed to the Department Communication Pathology.

bamu	bumɛ	bimu	bɛmu
bamɛ	buma	bima	bɛma
daba	dubu	dibi	dɛbɛ
dabi	dubi	dibɛ	dɛbi
dabu	dubɛ	dibu	dɛbu
dabɛ	duba	diba	dɛba
dama	dumu	dimi	dɛmɛ
dami	dumi	dimɛ	dɛmi
damu	dumɛ	dimu	dɛmu
damɛ	duma	dima	dɛma
maba	mubu	mibi	mɛbɛ
mabu	mubi	mibɛ	mɛbi
mabɛ	mubɛ	mibu	mɛbu
mabi	muba	miba	mɛba
mada	mudu	midi	mɛdɛ
madu	mudi	midɛ	mɛdi
madɛ	mudɛ	midɛ	mɛdu
madi	muda	mida	mɛda

Level 3 C1 V1 C+ V1

baba	budu	bidi	bɛbɛ
bada	budu	bidi	bɛdɛ
bama	bumu	bimi	bɛmɛ
dada	dudu	didi	dɛdɛ
daba	dubu	dibi	dɛbɛ
dama	dumu	dimi	dɛmɛ
mama	mumu	mimi	mɛmɛ
maba	mubu	mibi	mɛbɛ
mada	mudu	midi	mɛdɛ

Level 4 C1 V+ C2 V1

badu	bamu	badi	bami
bɛdu	bɛmu	budi	bumi
bidu	bimu	bɛdi	bɛmi
bɛda	bɛma	badɛ	bamɛ
bida	bima	bidɛ	bimɛ
buda	buma	budɛ	bumɛ

dabu	damu	dabi	dami
dɛbu	dɛmu	dɛbi	dɛmi
dibu	dimu	dubi	dumi

dabɛ	damɛ	dɛba	dɛma
dibɛ	dimɛ	diba	dima
dubɛ	dumɛ	duba	duma

mabu	madu	mabi	madi
mɛbu	mɛdu	mɛbi	mɛdi
mibu	midu	mubi	mudi

mabɛ	madɛ	mɛba	mɛda
mibɛ	midɛ	miba	mida
mubɛ	mudɛ	muba	muda

Level 5 C1 V+ C+ V+

bami	dami	mabi	madi
bidɛe	didɛ	mibɛ	midɛ
bɛbu	dɛbu	mɛbu	mɛdu
buma	duma	muba	muda

Words for Stage 1

Afrikaans	*English*
baba	daddy
mamma	debbie
miemie	dudu
dadda	dadda
mammie	
dudu	

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