CHAPTER ONE

ORIENTATION AND PROBLEM STATEMENT

1.1 Introduction

A relevant research question can only develop from a valid and scientifically formulated problem statement. In this chapter, the researcher's orientation to the specific field of study is provided as a framework for the problem statement. The problem statement, in turn, provides the rationale for the study as well as the foundation for the research question. The orientation, problem statement and rationale for the study are presented as follows.

1.1.1 Orientation and Problem Statement

The positive impact that a cochlear implant has on the speech recognition skills of individuals with a profound sensory neural hearing loss, especially in the case of postlingually deafened adults, has been widely reported (Dowell, 2005; Bai & Stephens, 2005). The improvement and gains in speech recognition demonstrated by late-implanted prelingually deafened (LIPD) adults are more modest and less significant, however, than those of postlingually deafened adult cochlear implant users (Zwolan, Kileny & Telian, 1996) and therefore implantation of this population remains a particularly contentious issue. There are indications in the literature that LIPD individuals can obtain varying degrees of benefit from a cochlear implant, although the user's characteristics and subjective experiences seem to be major contributing factors in the improvement of communication-related skills and quality of life (Wooi Teoh, Pisoni & Miyamoto, 2004; Zwolan, Kileny & Telian, 1996).

The general problem within the South African context is that the advantages, limitations and disadvantages of cochlear implantation in prelingually deafened, late implanted adults have been insufficiently explored especially with regard to communication-related outcomes. The decision-making process by cochlear implant teams in terms of candidacy guidelines for this specific population is currently complicated and even frustrated by a lack of scientifically based observations and information. It is also evident that general controversy exists throughout the world about the success of cochlear implantation in this specific population (Schramm, Fitzpatrick & Seguin, 2002).

The purpose of this study is therefore to investigate and describe both the self-reported and the objectively assessed communication-related outcomes of LIPD adults.

1.1.2 Background and rationale for the study

The cochlear implant is a device that restores useful hearing in severely to profoundly deaf people, when the organ of hearing situated in the inner ear has not developed or is destroyed by disease or injury. It bypasses the inner ear and provides information to the hearing centers through direct stimulation of the auditory nerve (Clark, 2003). Cochlear implants are currently an accepted form of rehabilitation for deaf individuals, but applicants are subjected to a selection process in order to ensure that appropriate candidates are selected for implantation.

Selection criteria are used in the first place to ensure successful outcomes in more instances and secondly to ensure that patients have realistic expectations of the possible benefits and risks. In a developing and socio-economically diverse context, like South Africa, prioritization of patients is important due to limited financial and human resources (Van Dijk, C. Personal Communication, April 2005; Clark, 2003). Candidacy requirements have also changed vastly over the last several years. Prelingually deafened adults may currently be considered for late implantation, but these candidates in particular require counselling regarding realistic expectations and the possible unpredictability of the outcomes in these cases (Skinner, 1995). Although considerable individual differences in the outcomes of cochlear implant use have been noted (Wooi Teoh, Pisoni & Miyamoto, 2004), LIPD adults tend to demonstrate smaller improvement than postlingually deafened adults in domains related to listening and speech recognition (Dowell, 2005).

According to three of the major companies developing and manufacturing cochlear implants, namely *Cochlear Pty. Ltd.* (2005), *MEDEL Corporation* (2006) and *Advanced Bionics Corporation* (2006), the following adults are considered successful candidates for a cochlear implant:

- Persons with bilateral severe-to-profound or moderate-to-profound sensori-neural hearing loss.
- Persons who obtain limited benefit from appropriate amplification and have speech recognition abilities that consist of 50% or less open-set sentence discrimination.
- Persons who express a desire to be part of the hearing world and to be able to communicate via spoken language.
- No minimum or maximum age restriction for candidates exists.

Upholding these criteria for the selection of appropriate candidates will ensure that optimal outcomes can be expected.

According to Tyler and Tye-Murray (1991), cochlear implants have an enormous impact on the lives of thousands of postlingually deafened adults and recipients derive substantial benefit from this type of rehabilitative device, especially when they use it in conjunction with speech reading. Cochlear implants provide benefits not only in terms of sound awareness, speech recognition and communication skills, but also in various psychological domains. The literature has indicated significant correlations between improved quality of life and improved communication after implantation (Bai & Stephens, 2005). It is therefore considered a realistic expectation that positive short-term outcomes in the recipient's auditory receptive skills will develop into a cascade of medium and long-term outcomes in terms of his/her social independence and quality of life (Sanderson & Nash, 2001).

The outcomes of LIPD adults cover a wide range and individual differences occur, especially as the time of deafness increases. The outcomes will therefore be more uncertain for those cochlear implant users who have a shorter term of deafness, as is the case with postlingually deafened adults (Waltzman, Roland & Cohen, 2002). The audiological, speech, and language outcomes of prelingually deafened adults are therefore related to the duration of auditory deprivation before implantation as well as to the age of implantation. Due to the long period of deafness and implantation after the age of 12 years in LIPD adult individuals (the time up to the age of 12 years is regarded as the sensitive period for cochlear implantation), the prognosis for successful cochlear implantation is poorer than for postlingually deafened adults (Wooi Teoh, Pisoni & Miyamoto, 2004; Waltzman, Roland & Cohen, 2002). Receiving a cochlear implant at a younger age predicts superior post-implantation outcomes and the opposite are expected for a late implantation (Moody-Antonio, Takayanagi, Masuda, Auer, Fisher & Bernstein., 2005).

Prelingually deafened adults, whose onset of profound hearing impairment was prior to the normal development of auditory, speech and language skills, have a lack of auditory input from early in life and this severely affects the intelligibility of their speech and their level of language competence. This long-term sound deprivation also causes morphological and physiological changes in the neural structure of the auditory pathway (Tong, Busby & Clark, 1988). The LIPD deafened adult's ability to use the new electrically coded speech information for perception and production differs from the use of the same information by postlingually deafened adults (Busby, Roberts, Tong & Clark, 1991).

Observations in this regard have led to the general perception that LIPD adults receive only minimal benefit from a cochlear implant. The main disadvantage of implanting LIPD adults is that they do not show significant improvement in open-set speech recognition and perception. Their lack of progress is particularly disturbing when contrasted with the improved performance of postlingually deafened adults (Zwolan, Kileny & Telian, 1996). It has also fueled the controversy surrounding the appropriateness of implanting LIPD adult individuals with a cochlear implant.

Prelingually deafened individuals are often handicapped in world, social, and linguistic knowledge, as a result of profound deafness during their language-learning years. Their limited experience and poor or no skills development in these areas cause additional difficulty in obtaining information from incomplete acoustic and speech reading cues (Skinner, Binzer, Fears, Holden, Jenison & Nettles, 1992). Relatively little research regarding the outcomes of this specific population has been published; nevertheless, reference to the lack of significant advantages in cochlear implant use in this population is found in the literature (Skinner et al, 1992; Moody-Antonio et al, 2005). Some researcher find that LIPD individuals experience the value of speech information that they receive relatively insignificant (Zwolan, Kileny & Telian, 1996). Subjectively, they experience unpleasant sound sensations and facial nerve stimulation (Zwolan, Kileny &

Telian, 1996; Skinner et al., 1992) and this can therefore be described as a definite disadvantage of the implantation. LIPD adults with long-term deafness also reach their performance plateaux sooner than patients who receive implants during their early childhood, and this may influence the significance of sustained outcomes. LIPD adult cochlear implant users reportedly reach their plateau within six months to one year, in contrast to the continuing improvement of auditory skills demonstrated by postlingually deafened cochlear implant users three to five years after implantation (Wooi Teoh, Pisoni & Miyamoto, 2004).

It is important, however, not to consider speech recognition and auditory-alone performances exclusively in determining the final benefit of the cochlear implant, because of the great differences in individual outcomes and the substantial benefit that some individuals derive from the implant (Zwolan, Kileny & Telian, 1996). It seems relevant to view the possible benefits of cochlear implants for LIPD adult cochlear implant recipients from a broader perspective.

Literature has indicated that LIPD adult cochlear implant users often report an increase in their use of auditory/oral communication after the implant, with effect on both their receptive and expressive communication skills. There is also a marked improvement in their ability to detect or register sound via the cochlear implant, especially environmental sounds. Their improvement in auditory abilities also leads to the improvement of their speech production skills (Zwolan, Kileny & Telian, 1996; Waltzman, Cohen & Shapiro, 1992).

The advantages of a cochlear implant for these individuals extend further, more social satisfaction and overall improvement in quality of life. Occupational progress, and consequently improved self-esteem, is experienced due to the use of a cochlear implant. There is often a feeling of increased independence and implant recipients are more social and less lonely as a result of getting the implant (Wooi Teoh, Pisoni & Miyamoto, 2004). It is important, therefore, to determine both self-reported and objective advantages and disadvantages of cochlear implant use in LIPD adults. Determining both self-reported and objectively assessed outcomes will enable the researcher to establish a holistic view of this specific population of people who function with a cochlear implant (Zwolan, Kileny & Telian, 1996).

Due to the varying degrees of benefit experienced by prelingually deafened adults, late cochlear implantation is cautiously warranted by cochlear implant teams internationally (Waltzman, Roland & Cohen, 2002). This is also the case with the Pretoria Cochlear Implant Team (Van Dijk, C., Personal Communication, January 2006). It seems that there is a critical need for scientifically researched and meticulously reported information regarding the communication-related outcomes (objectively assessed as well as self-reported) of a late cochlear implantation in prelingually deafened adults. The investigation and description of implant outcomes for this particular group and knowledge about their hearing history, speech and language development, and use of residual hearing will make evidence-based recommendations possible. These recommendations will not only inform the cochlear implant team about the potential subjective and objective outcomes of a cochlear implant for these individuals, but will provide guidelines for informed decision making regarding a variety of issues to be considered including the ultimate cost-effectiveness of the cochlear implant for this population (Zwolan, Kileny & Telian, 1996).

1.2. Research question

A preliminary review of the subject literature indicated that the available information about the outcomes of a late cochlear implant for prelingually deafened adults is insufficient. The current study proposes to answer the following question: does a late cochlear implant have an impact on the communication-related outcomes, both self-reported and objectively assessed, of prelingually deafened adults; and if so, what is the nature of the impact? The aim of this study is therefore to determine the self-reported and objectively assessed communication-related outcomes of cochlear implant use in prelingually deafened adults, in order to provide scientifically based information that could guide cochlear implant teams in setting candidacy criteria for late implantation of prelingually deafened adults.

1.3 Definitions of terminology used in the study

The terminology used in the study is defined below, in order to avoid ambiquity and possible misconstruction.

- **Cochlear Implant:**

  A cochlear Implant is a surgically implanted device that is used as treatment for severe-to-profound sensory-neural hearing loss in children and adults, to provide useful hearing and promote improved communication. It bypasses the inner ear and the components that work together provide information to the hearing centers through direct stimulation of the hearing nerve, providing the hearing-impaired individual with sound (Clark, 2003; Katz, 2002)

- **Prelingually deafened:**

  Prelingual deafness refers to the loss of hearing sensitivity occurring before the development of speech and language skills. The occurrence of this type of deafness can be congenital or adventitious (Nicolosi, Harryman & Kresheck, 1996).

- **Adult:**

  The term *adult* as used in this study will refer to an individual aged 16 years or older. An adolescent is regarded as an adult language user from the age of 16 years (Owens, 2001).

- **Late implantation:**

  This term is used in the current study to imply that the adult received a cochlear implant after a period of at least ten years of auditory deprivation (with or without the use of a hearing aid), as suggested by Wooi Teoh, Pisoni and Miyamoto (2004).

- **Communication:**

  Communication is the process which an individual uses to exchange information and ideas, to express needs and desires, and to relate experiences, knowledge, and feelings to others. This process is an active one that involves encoding, transmitting, and decoding of the intended messages. For communication to be successful, the communicator must be able to use and combine his auditory, speech, and language skills. A person's ability to communicate effectively improves his/her quality of life (Bai & Stephens, 2005; Owens, 2001; Nicolosi, Harryman & Kresheck, 1996).

- **Self-reported outcomes:**

  Self-reported outcomes (in this study) will refer to outcomes subjectively perceived and subsequently reported by the late-implanted prelingually deafened adults.

- **Objectively assessed outcomes:**

  Objectively assessed outcomes will refer to results gained from clinical testing, such as hearing thresholds, percentage word discrimination, and scores on language and speech intelligibility assessment instruments.

- **Auditory functioning:**

  Auditory functioning refers to the perception of sounds and speech via the hearing mechanism. The measurements of auditory function will include an entire test battery of pure-tone and speech audiometry together with immittance measurements in order to glean the most meaningful information (Bess & Humes, 1999; Nicolosi, Harryman & Kresheck,1996).

- **Language:**

  Language can be defined as a socially shared code used for communication, a conventional system for representing concepts through the use of an organized set of arbitrary symbols and rule-governed combinations of those symbols. Language involves an interrelation of the reception, integration and expression of information (Owens, 2001; Nicolosi, Harryman & Kresheck, 1996).

- **Speech intelligibility:**

  For the purpose of this study *intelligibility* refers to a judgment made by a clinician based on how much of an utterance can be understood.

Measurements of the degree of speech intelligibility are based on a subjective, perceptual judgment generally related to the percentage of words that are understood by the listener (Baumann-Waengler, 2000).

- **Quality of Life:**

  Quality of life can be defined as individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the health, social relationships, and communication efficacy of the persons involved, and by their relationships to salient features of their environment (Bai & Stephens, 2005).

- **Primary School:**

  A primary school is an institution where children receive the first stage of compulsory education known as primary or elementary education (www.wikipedia.org). Within the South African context, primary school starts at grade one and continues until grade seven.

- **Secondary School:**

  A secondary school is an educational institution where the final stage of compulsory schooling, known as secondary education, takes place. It follows on from primary or elementary education (www.wikipedia.org). Within the South African context, secondary school starts at grade eight and continues until grade 12.

- **Nucleus Freedom with Contour Advance:**

  The Contour Advance electrode is a 24-channel electrode. It consists of a Softip electrode that is designed to protect the delicate cochlea during surgery, and a thin, self-curling array that is designed to place the electrodes close to the hearing nerve, for focused stimulation and increased power efficiency, while applying less pressure to the cochlear structures (www.cochlearamericas.com).

- **Nucleus 24 Double Array:**

  The Nucleus 24 Double Array is designed for people with ossification or bone growth in their cochlea. This bone growth may block the space inside the cochlea and prevent the use of an implant with a single array. The Double Array has two shorter electrode arrays, each with 11 channels for stimulation. It can provide better performance for people with ossified cochleae than a single array (www.cochlear.co.uk).

- **Nucleus 24 Contour Advance:**

  The Nucleus 24 Contour Advance has the Softip electrode array, designed to protect the cochlea during surgery and to preserve residual hearing. It places the channels of stimulation close to the hearing nerve to take advantage of the natural pitch distribution in the cochlea (www.cochlear.com).

- **Ontology:**

  Ontology is the study of the nature of being, existence, or reality in general, as well as of the basic categories of being and their relations. Ontology deals with questions concerning what entities exist or can be said to exist, and how entities can be grouped, related within a hierarchy, and subdivided according to similarities and differences (www.wikipedia.org).

1.4 Division of chapters

Chapter 1: Orientation and Problem Statement

The aim of chapter one is to outline the introductory orientation to the research project. Current research on the topic is evaluated and shortcomings and problems reported in the literature are discussed. The rationale for the study is explained within the context of the study field and the research question is formulated. All relevant concepts and terms relating to the subject are defined and will serve as a road map for the researcher.

Chapter 2: Literature review of the predictive factors that influence the success of late-implanted prelingually deafened adults and the outcomes of cochlear implant use in this specific population group.

This chapter comprises the theoretical component of the study and provides a comprehensive overview of the literature relating to cochlear implantation in the adult population. The concepts and constructs regarding the subject are scrutinized by means of a literature study and survey. The focus of this chapter is the critical evaluation of the existing research on this specific issue and value and relevance of these studies for the current research project.

Chapter 3: Research methodology

The aim of chapter three is to describe the methodology of the research. The research design, the main aim, and the sub-aims of the study are described. A combined qualitative and quantitative research design was utilized and included a structured interview and test battery measurements. A description of the participants, material and apparatus used and data collection, - recording, and - analysis procedures are included in this chapter in such a way that the reader or any other researcher will be able to duplicate the study exactly in every aspect.

Chapter 4: Results and discussion

Chapter four presents all the collected and processed data as research results and findings. The results are followed by the discussion and interpretation of each finding according to the different sub-aims.

Chapter 5: Conclusion and recommendations

The conclusions of the researcher with regard to each sub-aim are discussed based on the findings of the study. Clinical implications for the Pretoria Cochlear Implant Programme, audiologists in general, and potential prelingually deafened cochlear implant candidates are discussed and are followed by a critical evaluation of the study. Recommendations regarding further research are provided.

1.5 Conclusion

The positive impact that a cochlear implant has on the speech recognition skills of individuals with a profound sensory neural hearing loss, especially in the case postlingually deafened adults, has been widely reported (Dowell, 2005; Bai & Stephens, 2005; Gomaa, Rubinstein, Lowder, Tyler, Gantz 2003). The improvement and gains in speech recognition demonstrated by prelingually deafened adults on the other hand, are more modest and less significant (Zwolan, Kileny & Telian, 1996). However, the benefit that a cochlear implant, received at a later stage of life, can offer a prelingually deafened individual remains a particularly contentious issue. There are indications in the subject literature that prelingually deafened individuals derive varying degrees of benefit from a cochlear implant. The user's characteristics and subjective experiences seem to be major contributing factors in the improvement of communication-related skills and quality of life (Wooi Teoh, Pisoni & Miyamoto, 2004; Zwolan, Kileny & Telian, 1996). It is important, therefore, to determine both self-reported and objectively assessed communication-related outcomes of these specific individuals. Decisions based on both types of outcomes may enable the cochlear implant team to determine appropriate candidacy for LIPD adults.

The goal of this chapter was to introduce the subject of the research, to regard the research project from a certain perspective, and to provide a rationale for conducting the study. The positive short-term goals experienced by postlingually deafened adult cochlear implant users and the subsequent cascade of medium and long-term outcomes were discussed in order to create a frame of reference for what is regarded as successful communication-related outcomes of cochlear implant use. Although the communication-related outcomes of LIPD adults will not be compared to outcomes of postlingually deafened adult cochlear implant users, this frame of reference may be used to determine if the outcomes of LIPD adults are generally significant and whether cochlear implantation in this specific population is cost-effective and socio-economically viable. The literature was used to support the argument that it is important in determining the success of cochlear implant use in this population to look not only at objective measurements, but also at self-reported outcomes. From the literature, it is obvious that there is a need for knowledge and information about what the communication-related outcomes of

LIPD adults are, in order to determine if cochlear implantation in the LIPD population is successful or not. A description is provided of all relevant terminology used in the research, followed by a brief outline of each of the five chapters.

CHAPTER TWO

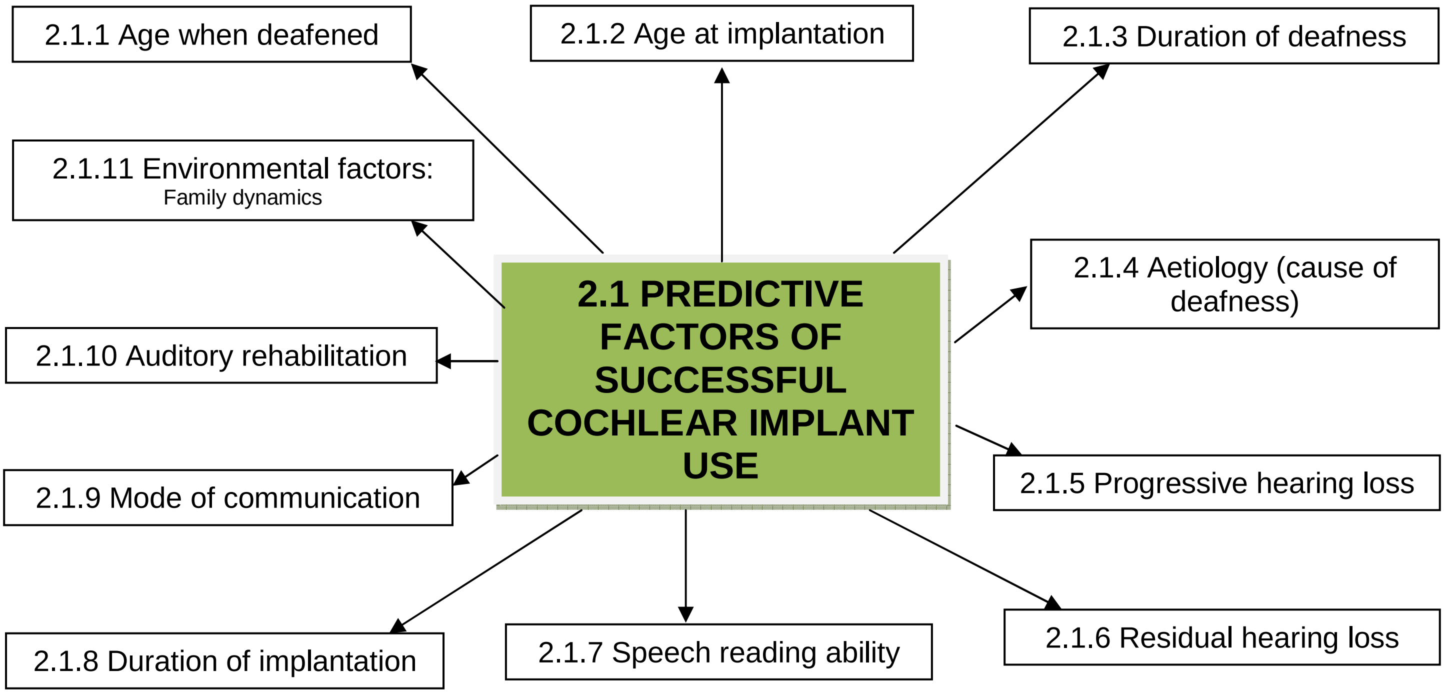
PREDICTIVE FACTORS OF SUCCESSFUL COCHLEAR IMPLANT USE: THE COMMUNICATION-RELATED OUTCOMES OF A COCHLEAR IMPLANT IN LATE-IMPLANTED PRELINGUALLY DEAFENED ADULTS

The factors that are likely to produce good or poor results need to be considered when predicting the outcomes of adult cochlear implant users. Much research effort has been invested in the identification of factors that are predictive of the results of a cochlear implant. The data from this research serve two main purposes:

- Where resources are limited and expensive technology is required, there is an understandable desire to have a system of priorities whereby those candidates most likely to achieve more successful results, are implanted before those who are less ideal candidates; and
- Information about the probable outcomes for each particular case can be used to counsel the candidate about roughly the degree of benefit they might expect from their implant.

Both of these applications of predictive factors could apply when cochlear implantation is considered for a prelingually deafened (potentially LIPD) adult. This chapter will highlight some of the factors that determine successful cochlear implantation in adults, as reported by other researchers (Clark, 2003; Dowell, 2005; Waltzman, Roland & Cohen, 2002; Wooi Teoh, Pisoni & Miyamoto, 2004).

The potential for successful use of a cochlear implant is not the same over the broad spectrum of individuals with profound hearing impairment, with the consequence that some individuals may experience greater and other lesser benefit from the cochlear implant (Waltzman, Niparko, Fisher & Cohen, 1995). The literature indicates that the LIPD adult population in particular exhibits considerable individual differences in cochlear implant use and therefore presents a greater challenge than the population of late-implanted postlingually deafened implant users. Individual members of the LIPD population demonstrate less gain in objectively assessed outcomes, but they report satisfaction and improvement in language and speech skills, as well as in their quality of life (Zwolan, Kileny & Telian, 1996). Both objective and subjective (self-reported) outcomes therefore need to be considered in order to obtain a realistic and holistic view of LIPD adults' outcomes with the use of the cochlear implant. In addition, the objectively assessed and the self-reported communication-related outcomes of LIPD adults need to be reviewed in order to carefully document the full potential of cochlear implantation for adults who were prelingually deafened. Figure 2.1 summarises and illustrates the predictive factors, as well as the outcomes to be discussed.



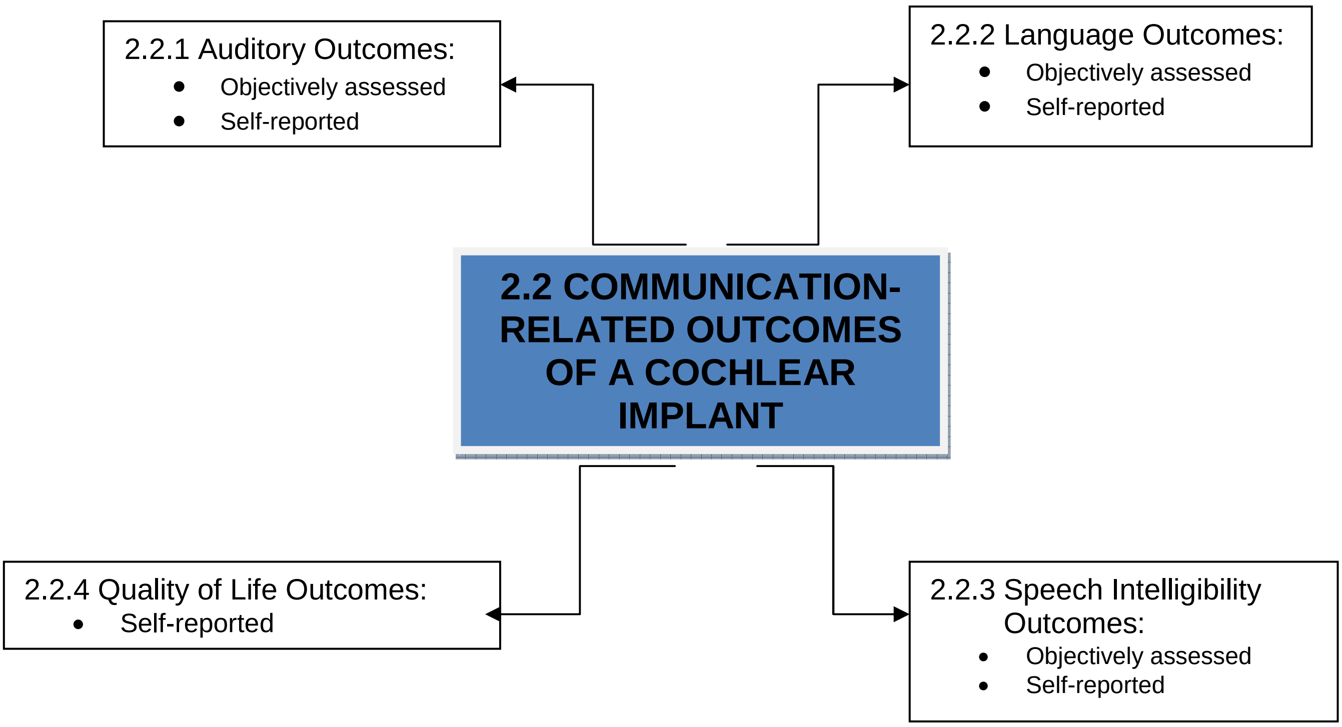


Figure 2.1: Summary of predictive factors and communication-related outcomes of cochlear implantation (Adapted from Clark, 2003)**.**

As can be seen from Figure 2.1, age when deafened, age of implantation, and duration of deafness are the first predictive factors that will be discussed. A review of the influence of the aetiology, progressive hearing loss, residual hearing loss, speech-reading ability, and duration of implantation on cochlear implant outcomes will follow. The mode of communication and auditory rehabilitation are two predictive factors that may influence cochlear implant outcome, especially in the LIPD adult population, and therefore need to be addressed. In conclusion to this subsection, family dynamics as an environmental component will be examined as predictive factor.

A discussion of the communication-related outcomes of a cochlear implant specific to the LIPD adults will follow and will target auditory, language, speech intelligibility, and quality of life outcomes.

2.1 Predictive factors of successful cochlear implant use

2.1.1 Age when deafened

The onset age of deafness has important implications for cochlear implantation, depending on whether the hearing impairment occurred before (prelingually), during (perilingually) or after (postlingually) the acquisition of listening and language behaviour (NIH, 1995). A period of experience of normal hearing is considered by most cochlear implant groups to be a prerequisite for suitability for cochlear implantation in adults (Cooper, 1991). In view of this prerequisite, it is logical that the vast majority of adults coming forward for consideration are postlingually deafened adults who had several years' experience of normal hearing (Cooper, 1991). However, prelingually deafened adults are sometimes considered, although no or limited normal hearing was present before deafness. *Age when deafened* will consequently play different roles in these two vastly different populations. Age when deafened is not considered a significant factor in postlingually deafened adults, but it is critical in the case of adults who were deafened before or during their critical period of language development (Clark, 2003).

Data on cochlear implantation presented at the National Institute of Health Consensus Development Conference (1995) suggested that adults with postlingual onset of deafness had better auditory performance than adults with prelingual or perilingual onsets. Summerfield and Marshall (1995) reported that adults who were deafened more recently were found to have greater abilities to understand speech and other sounds, possibly reflecting survival of auditory nerve fibres, memory for sounds, and cortical flexibility to interpret novel sensations. The age that the deafness was acquired has significant relevance, therefore, when outcomes of cochlear implant use have to be predicted, because it has a great impact on the performance of adults with a cochlear implant.

The difference in the onset age of deafness between postlingually and prelingually deafened adults leads to large individual differences in performance. Adult cochlear implant users who lost their hearing after developing normal language maintain a central representation of language that has a structure similar to the representation they had when they heard acoustically. The cochlear implant provides enough stimulation to allow listeners to access this lexical information (Clark, 2003). In contrast, users who lost their hearing prior to the development of speech and language skills demonstrate poorer speech perception (Zwolan, Kileny & Telian, 1996), due to their lack of established central representation of language. Speech perception may therefore be influenced by the predictive factor *onset age of deafness*.

There also appears to be a relation between the period of normal hearing prior to deafness and performance on speech-reading tasks. In research by Skinner, Binzer, Fears, Holden, Jenison and Nettles (1992), the two patients who heard sounds normally for the first six years of life, could draw on their knowledge of language to speech-read more quickly and accurately than the two patients who became deaf at birth and at nine months of age respectively. It can therefore be deduced that speech-reading ability is positively influenced by the duration of the period of normal hearing prior to deafness, and consequently by the acquired knowledge of language.

The positive effect of a longer period of normal hearing before deafness (later age when deafened) probably gave rise to the current trends in implantation that focus on implanting adults with a shorter duration of deafness, as successful hearing outcomes are likely to occur. However, this should not be interpreted as an indication that cochlear implantation is not suitable for any candidates with a long duration of deafness; indeed, some LIPD adults are reported to have gained measurable benefits from implantation (Mawman, Bhatt, Green, O'Driscoll, Saeed & Ramsden, 2004).

2.1.2 Age at implantation

Implantation should be performed as early as possible to avoid the effects of auditory deprivation and optimize the chances of normal development of both hearing and speech (Lenarz, 1997). Persons who receive implants at a younger age and have a shorter period of auditory deprivation are more likely to achieve good outcomes (Kirk, 2000). It is therefore considered beneficial that people now apply for implantation earlier with a shorter duration of deafness, whereas initially older people had a longer duration of deafness when presenting for implantation (Clark, 2003).Unfortunately, not all persons obtain their cochlear implant at an early age, and prelingually deafened adults are a case in point. The National Institute of Health (1995) data indicated that prelingually deafened persons who were implanted in adolescence or adulthood did not achieve as good auditory performance as those implanted during childhood or as postlingually deafened adults. Age of implantation may therefore influence outcomes of cochlear implant use.

Open-set speech understanding is greatly enhanced by a younger age at time of implantation. Research results by Waltzman and Shapiro (2000) confirmed earlier studies that used older processing strategies, in their findings that the longer the time of deafness and the older the age of implantation, the poorer the prognosis for development of auditory-only open-set speech recognition was. Poorer speech perception results are a tendency in the performance of congenitally deaf persons implanted in adulthood. Furthermore, age of implantation may even have a negative effect on the prelingually deafened adults' visual speech discrimination, as was found by Van Dijk, Van Olphen, Langereis, Mens, Brokx and Smoorenburg (1999). This study indicated that cochlear implant users with higher ages present with poorer visual open-set speech discrimination. It has therefore been argued that cochlear implants may not be effective at a relatively late age in the congenitally deaf population. However, individual differences and benefits in this population do occur, and cochlear implantation may be successful, even after ten years of auditory deprivation (Snik, Vermeulen, Geelen, Brokx & Van der Broek, 1997). In the light of all these outcomes, and in the presence of certain factors such as auditory experience and morphological and physiological changes that influence prelingual performance, the importance of performing the implantation of the hearing prosthesis as early as possible for the congenitally deafened population, must be underscored (Tong, Busby & Clark, 1988).

2.1.3 Duration of deafness

The effectiveness of a cochlear implant, especially as reflected in the ability to obtain open-set speech discrimination, consistently declines with increasing duration of profound deafness before implantation (Dawson, Blamey, Rowland, Dettman, Clark, Busby, Brown, Dowell & Rickards, 1992). Congruently, the ability of postlingually deafened adult implantees to identify spoken words has been found to be associated with the recency of the onset of the profound deafness in the implanted ear (Clark, 2003). Therefore, duration of deafness is regarded as the main general factor that correlates with outcomes of cochlear implantation, especially with speech perception (Clark, 2003; Mawman et al., 2003). Duration of deafness can be used to predict outcomes of a cochlear implant for either or both of two reasons:

- It can serve as indication of the survival of memories of sounds of speech; and
- It can serve as indication of the physiological responsiveness of the auditory pathways

(UK Cochlear Implant Study Group, 2004)

A person with a long duration of deafness who receives a cochlear implant can often perceive phonemes and have good results for place pitch discrimination, but cannot readily integrate the information and understand speech (Clark, 2003). As deafness endures, even in postlingually deafened adults, acquired skills and knowledge may decline and some behaviour that works against successful adaptation to a sensory device may develop (NIH, 1995). Postlingually deafened adults with longer duration of deafness display poorer outcomes and consequently reduced effectiveness in the domains of speech intelligibility, health utility, and ontologically relevant quality of life (UK Cochlear Implant Study Group, 2004).

The degree of this effect is greatly larger in the LIPD population. A lack of auditory stimulation for most of a LIPD adult's life appears to be related to a more limited ability to discriminate and identify speech sounds with the cochlear implant (Skinner et al, 1992). The combination of early onset of deafness, lack of effective auditory training, and no or little auditory stimulation are related to limited performance in terms of using acoustic information provided by the implant (Skinner et al, 1992). According to Wooi Teoh, Pisoni and Miyamoto (2004), there is also a clear relationship between the duration of auditory deprivation before implantation and the user's eventual audiologic performance plateau, which occurs much faster than in the case of a postlingually deafened adult cochlear implant user. The effect of the longer duration of deafness therefore extends into widespread areas of functioning.

The two main factors that have prevented widespread implantation in adults with prelingual deafness are the long duration of deafness and the nature of neural plasticity in human beings. In addition, this population has typically presented with limited improvement in speech reception skills. Prolonged bilateral deafness may bring about loss of central auditory processing skills, which in turn may limit a person's ability to learn to process the novel signal from a cochlear implant. This is potentially the case with LIPD adult cochlear implant users. The duration of deafness in the implanted ear is expected to correlate with the level of deterioration of ganglion cells in the cochlea, another fact that could limit perceptual performance (Wooi Teoh et al, 2004). Therefore more limited benefit with regard to speech perception is expected for persons with a longer duration of profound deafness and/or congenital aetiologies (Sarant, Cowan, Blamey, Galvin & Clark, 1994).

In reality, any human population presents with a wide range of performance. This is also true of prelingually deaf adults and individual differences must be accounted for. It has been established that some LIPD adults can obtain substantial open-set speech recognition after implantation using currently available speech strategies (CIS, SPEAK & ACE). However, due to this population's long duration of deafness, these adults will most likely require longer periods of rehabilitation for adequate speech perception and even then relatively poor results may be expected (Clark, 2003).

In contrast, individuals with shorter duration of auditory deprivation tend to achieve better auditory performance (NIH, 1995). Therefore, the duration of auditory deprivation can be used as one of the strongest prognostic factors in cochlear implant performance (Quaranta, Bartoli & Quaranta, 2004), especially in the LIPD adult cochlear implant users. Despite the advanced qualities of new technology, Waltzman and Shapiro (2000) revealed that period of deafness continues to be a significant contributor to performance. It is also possible that neural structures and mechanisms responsible for auditory processing are more adaptable to new inputs at a younger age (Tong, Busby & Clark, 1988), and therefore age at implant is an additional factor that impacts on perfromance.

There clearly is a wide range of results, particularly as the period of deafness increases in length, and prospective candidates should have a clear perception of the uncertainty of the outcome (Waltzman, Roland & Cohen, 2002). Persons with a long duration of profound deafness should be counselled appropriately about the likely benefits and limitations of a cochlear implant (Mawman et al., 2003).

2.1.4 Aetiology

The aetiologies of severe to profound deafness in adults who are candidates for a cochlear implant are most commonly otosclerosis, meningitis complicated by labyrinthitis, Ménière's disease, head trauma injuries, surgery, viral disease, ototoxic drugs, otitis media, and vascular accidents. Autoimmune disease and acoustic neuromas are other possible causes of deafness (Clark, 2003). Prelingually deafened adults, however, acquired their deafness from birth to three years, or the hearing loss was congenital. Many of the children who are cochlear implant candidates have deafness of unknown origin and no family history of hearing impairment. In a significant number of losses the aetiology may also be of genetic origin, more specifically autosomal recessive, or for a small proportion Xlinked recessive or autosomal dominant (Clark, 2003). The aetiology has implications for the medical, educational, and psychological management of children with auditory disorders and is also considered when the prognosis is determined (Myklebust, 1965).

Within the South African context congenital hearing losses often go undetected for a long period, due to late identification of hearing loss in children (Swanepoel, Hugo & Louw, 2007). Identification is late because universal newborn hearing screening is not routinely done in all hospitals in South Africa. Consequently, difficulties arise in the determination of the cause of hearing loss when the cause must be determined a year or more after birth or after deafness was incurred.

Ménière’s disease has been found to correlate positively with the results obtained from a cochlear implant, whereas meningitis correlates negatively due to the possibility of reduced number of electrodes inserted because of labyrinthitis ossificans (Clark, 2003). It is important, therefore, to consider the cause of deafness when calculating the potential success of a cochlear implant in LIPD adults.

Additional factors regarding aetiology must also be considered. Undeveloped or limited auditory processing skills, as previously mentioned, may limit a patient’s ability to learn to process the novel signal from a cochlear implant (Dowell, 2005). Auditory processing disorder is due to a reduced ability to process sound signals higher up in the central auditory system and may be caused by a variety of anatomical and/or physiological phenomena originating from various locations in the auditory system (Widex, 2007).

2.1.5 Progressive hearing loss

The presence of a progressive hearing loss can be regarded as a positive predictive factor (Clark, 2003). A person with a progressive hearing loss often gradually becomes accustomed to, or learns to use degraded auditory information, and this skill will subsequently be useful when a cochlear implant is received. Clinical observation at the University of Melbourne has indicated that the experience of learning to use degraded auditory information carries over into better results with the distorted signal from electrical stimulation (Clark, 2003).

A prelingual hearing loss is incurred before the age of three and before any noteworthy speech and language skills have developed. If a young child has a progressive hearing loss and only becomes profoundly deaf at the age of three, limited but useful speech and language skills may still be present. Therefore, a progressive hearing loss between birth and three years would not necessarily have a significant effect on the LIPD population.

2.1.6 Residual hearing

In recent years, implant groups have become less conservative in their audiological criteria, and consequently persons with more diverse levels of residual hearing are being considered as candidates for a cochlear implant (Cooper, 1991). Encouraged by the favourable open-set speech understanding in the majority of postlingually deafened adults, cochlear teams have extended the indication for cochlear implantation to persons with residual hearing (Clark, 2003). Open-set speech discrimination and residual hearing are therefore interrelated.

The positive effect of residual hearing on cochlear implant outcomes can be explained on theoretical grounds. The degree of survival of the peripheral auditory neural elements is related to the better or poorer outcomes of cochlear implant use. Adults with residual hearing have generally reported significant benefits from cochlear implants, and these positive outcomes justify implantation in this group of persons. However, in general, the residual hearing in the implanted ear cannot be preserved at a useful level. In adults with pre-operative residual hearing, the postoperative speech recognition increases significantly compared to the best pre-operative condition with conventional amplification (Kiefer, Von Ilberg, Reimer, Knecht, Gall, Diller, Stürzebecher, Pfenningdorff, Spelsberg, 1998).

It is important to determine whether residual hearing and continuous use of hearing aids are also important prognostic factors. The stimulation of auditory pathways where there is neural integrity and the habit of connection to the world of sound may be responsible for the positive influence of these factors (Manrique, Huarte, Molina, Perez, Espinosa, Cervera-Paz & Miranda, 1995). Cochlear implants tend to provide similar or better levels of auditory performance in people with profound deafness as the levels experienced by people with severe hearing impairment who use hearing aids. Data presented at the NIH Consensus Development Conference raised the issue of whether cochlear implantation might give persons with severe hearing loss and some residual hearing even better performance than they can obtain with a hearing loss (NIH, 1995).

This is also the case with the LIPD adults. Research has demonstrated that the individual factor of residual hearing can affect post-implantation outcomes in this population (Wooi Teoh et al., 2004), and that it can be regarded as one of the best predictors of post-implantation speech perception (Moody-Antonio, Takayanagi, Masuda, Auer, Fisher & Bernstein, 2005). The expanded criteria for implantation, to allow the inclusion of individuals with severe to profound hearing loss, also apply to the LIPD population and can be one possible explanation for the improved speech perception, even though long-term deafness is present (Waltzman, Roland & Cohen, 2002).

It can be concluded that persons who have some usable residual hearing, tend to display better outcome in performance and quality of life postoperatively (Summerfield and Marshall, 1995) and therefore residual hearing must be considered when potential outcomes of cochlear implantation are determined.

2.1.7 Speech-reading ability

Auditory-oral communication takes place by means of combining hearing and speech-reading (Clark, 2003). The use of visual information from speech-reading provides the cochlear implant user with improvement in the speech-reading-plus-sound modalities and therefore with enhanced understanding (Cooper, 1991). According to Manrique et al. (1995) one of the clearest benefits from a cochlear implant concerns the development of speech reading. As was found by Van Dijk et al. (1999), the same attentional and cognitive abilities contributing to visual performance are used to obtain good audiological performance with the implant. Becoming a good speech-reader, therefore, demands practise and motivation in both visual and auditory modalities.

The influence of the cochlear implant user's speech-reading ability is dependent on certain factors. Most postlingually deaf adults with cochlear implants achieve audition-alone word recognition and communicate effectively when only auditory cues are used (Kirk, 2000). They are therefore able to converse fluently without speech-reading cues (Kirk, 2000). The improvement in their overall receptive skills (auditory and speech-reading) immediately after device activation often reduces their need for formalized speech-reading training (Katz, 2002).

For some cochlear implant users speech-reading enhances speech perception, as was found by Tyler and Kelsay (1990). These cochlear implant users' reliance on speech-reading is evident when telephone use is considered. Restricted telephone use by these implantees was reported by Tyler and Kelsay (1990), because speech-reading was not available to enhance their speech perception. Persons with a prelinguistic deafness usually fall in this category. These cochlear implant users are typically very skilled speech-readers and may not perceive improvement in their speech-reading abilities when using an implant (Schramm, Fitzpatrick & Seguin, 2002). LIPD adult cochlear implant users have been found to show improvement when using the cochlear implant combined with speech-reading, especially when compared to either speech-reading alone, or audition alone (Clark, Busby, Roberts, Dowell, Tong, Blamey, Nienhuys, Mecklenburg, Webb, Pyman & Franz, 1987). The prelingually deaf persons are able to successfully combine two sources of speech information for auditory-visual speech perception in everyday communication. This augmentative effect of visual speech perception can be regarded as an important component of the speech and language skills of hearing-impaired individuals (Busby Roberts, Tong & Clark, 1991, Moody-Antonio et al., 2005). However, speech-reading ability is still dependent on the cochlear implant user's knowledge of language (Skinner et al., 1992), and a firm language base is therefore a prerequisite if speech-reading is to be optimally utilized.

During counselling, cochlear implant candidates, especially prelingually deafened adults, should be informed of the possibility of limited speech understanding without speech-reading as a potential disadvantage, but need not be discouraged from pursuing cochlear implantation, at least for a short term. The fact that speech-reading contributes to better audition-plus-vision open-set speech discrimination can, however, be highlighted in order to inform them about better communication that may be expected with the using of both of these modalities (Shea, Domico & Orchik, 1990). When considering audition-plus-vision open-set speech discrimination, speech-reading abilities may act as a predictive factor for the outcomes in LIPD adult cochlear implant users. However, according to Clark (2003), when considering audition-alone open-set speech discrimination, a weak correlation exists between speech-reading ability and speech perception.

2.1.8 Duration of implantation

The successful use of the speech-processing strategy used by newly implanted postlingually deafened adults requires learning and adaptation. When the strategy provides enough information and presents input that is sufficiently speech-like, this learning process is shorter and more successful (Clark, 2003). The longer the duration of implant use, the better the learning curve that will be established. Word and sentence recognition, and to a lesser extent also vowel and consonant recognition, also improve over time, which is a further indication that the duration of implantation has a significant effect on speech perception (Clark, 2003). Therefore, duration of implant use is strongly correlated with good speech perception (Clark, 2003).

The duration of implant use has been shown to affect speech perception results, which raises the issue of when to assess implant users to be sure their performance has reached a plateau. Generally, speech perception improves rapidly over the first three months of implant use, with limited changes occurring later. On the other hand, some implant recipients appears to take a year or more to reach a plateau in their auditory skills (Dowell, 2005). In the study by Hamzavi, Baumgartner, Pok, Franz and Gstoettner (2003), all the postlingually deafened adults exhibited steady improvement over time, as the duration of implantation increased. The most dynamic enhancement took place in the first 12 months after fitting, but improvement continued up to 72 months following cochlear implantation.

In contrast, LIPD adults reach their performance plateau significantly earlier than persons who received their implant during their early childhood. Adult prelingual cochlear implant users typically reach their performance plateau within 6 months to 1 year after implantation. Even though performance plateaus are reached early, this population requires longer learning periods, presumably due the lack of prior exposure to sound and inadequate language development. Therefore learning will take longer with less success, and the shorter duration of implantation, which is often the case with LIPD adults, will also decrease this learning process. Significant variability is observed in the LIPD adult cochlear implant population (Bassim, Buss, Clark, Kolln, Pillsbury, Pillsbury & Buchman, 2005).

It can therefore be concluded that people who receive a cochlear implant at an earlier age experience continued improvement throughout their follow-up period, without reaching an asymptomatic level (Wooi Teoh et al., 2004). The longer the duration of the implantation, the better the results in terms of speech perception, as learning is required for both prelingually and postlingually deafened adults even with the strategies that provide the most information (Clark, 2003). The duration of implant use continues to be an important predictive factor regardng the outcome of cochlear implant use, especially in the LIPD population, and it is possible that as the length of device use increases, this population will achieve better speech perception results and continue to progress (Waltzman, Roland & Cohen, 2002; Quaranta, Bartoli & Quaranta, 2004).

2.1.9 Mode of communication

The mode or method of communication used by deaf and hearing impaired persons may include:

- ***Oral communication***: The person is taught to maximize his / her aided hearing, to listen, and to develop natural speech and language.
- ***Signing***: The person uses signs, body movements, facial expressions, gesture, mime and finger spelling. Signing includes Sign Language.
- ***Total communication***: The person uses any combination of signs, finger spelling, listening with amplification, speech, speech-reading, facial expressions, body language, reading and writing.

(Sanderson & Nash, 2001)

The communication strategy adopted before implantation influences postoperative results and persons with a cochlear implant do better if they have had an auditory-oral education (Clark, 2003). Implanted children and adults who use oral communication have shown higher scores on open-set word and sentence tests than implanted persons who use total communication approaches (Sarant et al., 1994).

The method of education/communication could be a factor influencing the results obtained in LIPD adult cochlear implant users. Two prelingually deafened adults with cochlear implants were the subjects in a study by Clark et al. (1987). Both lost their hearing at the same age. The first participant, however, was taught to sign, whereas the second participant was taught cued speech. With the cochlear implant, the speech perception of the second participant was better than that of the participant who relied on signing only. However, even with the use of Total Communication, poorer speech perception skills can be expected than with oral communication (Sarant et al., 1994) and oral communication is still regarded as the most appropriate mode of communication with the use of a cochlear implant. In the study by Manrique et al.(1994), the prelingually deafened adult cochlear implant users had developed oral mode of communication and therefore speech perception results were better. These results emphasize the importance of mode of communication as predictive factor of effective cochlear implant use.

In conclusion, it becomes clear that cochlear implant users who use oral speech and language as their sole mode of communication obtain better speech perception (Waltzman & Cohen, 1999) and in contrast, long-term congenitally deaf individuals who use manual communication do not obtain substantial auditory benefit after implantation (Waltzman, Roland & Cohen, 2002). The effect of mode of communication may therefore influence the cochlear implant outcome.

2.1.10 Auditory rehabilitation

The aim of rehabilitation is to enable cochlear implant users to use the implant maximally and consequently obtain optimal benefit from it (Clark, 2003). For postlingually deafened adults the skills to communicate effectively have already been acquired through the use of hearing prior to the onset of the profound hearing loss. Rehabilitation involves learning to reuse the same neural networks and communication skills, often with a signal that sounds distorted when compard to the previous signal. Furthermore, rehabilitation aims to present neural patterns of stimulation that most closely represent those from speech, and to take advantage of plasticity to reinforce the correct patterns through training. Training in the use of the perceptual information provided by the cochlear implant depends in part on the plasticity of the responses in the central auditory nervous system (Clark, 2003).

Rehabilitation entails training in the development of speech perception, speech production, and receptive and expressive language. The training can take place through direct involvement of the audiologist and speech-language therapist, or by indirect help through advice or instruction of parents. Auditory rehabilitation cannot take place without the use of a team approach and professionals familiar with cochlear implants must be involved to ensure successful outcomes for implant recipients (NIH, 1995).

During the process of candidacy and the subsequent preparation for cochlear implantation, individuals should be provided with information from a variety of sources. One way for such candidates to receive information from multiple sources is through consultation with a multi-disciplinary team (Olsen, 2006). The recommended team may consist of (but is not limited to) a team coordinator (usually an audiologist), ear nose and throat surgeon, audiologist, speech-language therapist, psychologist and the family. The input of a multi-disciplinary team is of the utmost importance and the team's expertise, skills and experience will provide the best possible treatment for the deafened person receiving an implant (Fraser, 1991). The team members and their function within the team are typically the following:

- The *team coordinator* is mainly responsible for the scheduling of appointments with the patient and his/her family as well as the initial information session. This member makes arrangements regarding fundraising projects, verification of payment, and help to insure the aid. As the team coordinator, this person is also responsible for the scheduling of meetings and ensures that all the team members are regularly informed.

The team coordinator (often the audiologist) is therefore responsible for the management of the database (Fraser, 1991; Tye-Murray, 2004; Clark, 2003).

- The *ear nose and throat surgeon* has the ultimate responsibility of the surgical procedure. This team member conducts pre- and postoperative assessments, initially to determine candidacy for cochlear implantation and surgery and thereafter to determine the success of the surgery. He/she is also involved in follow-up ear, nose and throat treatments (Fraser, 1991; Tye-Murray, 2004).

- The *audiologist* provides extensive pre-operative information which includes determination of candidacy and device options. The fitting of a hearing aid for a trial period is organized by the audiologist before the candidate is considered for implantation. During the surgical procedure, the audiologist assists with the intra-operative testing which may include electrical stapedius reflex testing, impedance measurements, NRT (neural response telemetry) measurements and EABR measurements, where necessary. After surgery, this member is responsible for the switch-on, the initial counselling, and thereafter the follow-up mappings. Post-operative assessments are also conducted to determine the benefit from the implant and map setting. If adjustment is needed, post-operative NRT measurements are taken to verify performance and map settings (Fraser, 1991, Olsen, 2006; Tye-Murray, 2004).

- The *speech-language therapist/hearing therapist* is uniquely qualified to evaluate overall communication function, suggest appropriate goals, and develop a treatment plan. Pre- and postoperative communication assessments are part of the speech-language therapist's job description. He/she assists with the switch-on and initial counselling. The speech-language therapist plays a crucial role in the supervision of the auditory training programme which is essential after implantation. Counselling, training and education of significant others are conducted by the speech-language therapist in order to optimize the use of the cochlear implant (Fraser, 1991; Olsen, 2006; Tye-Murray, 2004).

- The *psychologist* or *social worker* is responsible for pre-operative assessment to determine candidacy in terms of psychological status, family support, commitment and expectations. If any negative emotions or conflicts arise before or after implantation, the psychologist is responsible for counselling (Fraser, 1991; Tye-Murray, 2004).

- The *family* plays an important part in the cochlear implant process and family members are regarded as full members of the team. It is their responsibility to make an informed decision about the cochlear implant, by obtaining information concerning the whole process. Their commitment to the whole process and insistence on receiving training to facilitate appropriate management and auditory rehabilitation are very important. The family must liaise with the other team members, especially the audiologist and speech-language therapist, to make appropriate adaptations at home. All follow-up evaluations, mappings and training must be attended (Van Dijk, C. Personal Communication, April 2005).

All the team members in the multi-disciplinary team may contribute to better decision making by the candidate / cochlear implant user, which could also include the decision to participate in rehabilitation.

Many postlingually deafened early-implanted adults have mild rehabilitative needs following device adjustments. Their rehabilitation focuses primarily on training in the proper care and use of the device, using assistive listening devices with the implant, and training to maximize communication in difficult listening situations, such as with background noise and using the telephone (Katz, 2002). Although a cochlear implant can provide dramatic augmentation of the auditory information perceived by deaf adults, it is clear that training and intervention play a fundamental role in optimizing postimpant benefit (NIH, 1995).

The LIPD adult cochlear implant users are often expected to enrol in speech and language therapy before and after implantation (Zwolan, Kilen & Telian, 1996). Prelingually deafened adults have greater rehabilitative needs than postlingually deafened adults. The rehabilitation must include counselling dealing with satisfaction or dissatisfaction with the device and adjustments to their programmes to maximize the clarity of the electrical signal they are receiving. Speech perception training should also be provided to facilitate use of the device (Katz, 2002).

Auditory rehabilitation can therefore be regarded as an important factor predicting outcome of successful cochlear implant use, and it was determined that individuals with prelinguistic deafness, both early and late implanted, who receive intensive postimplantation auditory-verbal therapy may have the opportunity to achieve open-set perception (Schramm et al., 2002). However, auditory training does not increase the level of perceptual performance of the LIPD adults to a similar level as for early implanted postlingually deafened adults (Busby et al., 1991), which highlights the importance of having realistic expectations. The influence of auditory training on performance with the implant prostheses is a major issue in the selection and rehabilitation of LIPD adults and should be considered throughout the cochlear implant process (Busby et al., 1991).

2.1.11 Environmental factors: family dynamics

The family is the main environment for the developing child, but is also an integral part of the adult's life. The family's behavioural patterns, perception of hearing loss, emotional responses to the loss, and interaction with the child or adult with the hearing impairment, all exert powerful influences on the progress and development of that person (Schoeman & Fourie, 2004). The particular characteristics of an individual have a great influence on how he or she adapts to being hearing-impaired and on how the hearing loss in treated by his / her family, school, and greater society (Schoeman & Fourie, 2004).

Parental support is an important factor leading to good progress with the cochlear implant (Clark, 2003). Family dynamics are therefore an issue that must be considered when cochlear implant candidacy is determined. Research by Geers, Brenner, Nicholas, Uchanski, Tye-Murray and Tobey (2002) found that in the case of children, those with later onset of deafness, from smaller families, and with better- educated parents tended to have better outcomes. The ultimate benefits of successful cochlear implantation for the family are somewhat different for adults compared to children. For the adult it may be the ability to obtain an employment or take more responsibility in the workplace, to have more effective communication with his/her spouse or partner and thus have a more fulfilled marriage or relationship, and/or have a more active role as a parent or grandparent in the family (Clark, 2003). All of these aspects can provide the cochlear implant user with better quality of life and consequently better cochlear implant outcomes.

The use of a cochlear implant influences not only the user's daily life, but also the lives of his / her family. People close to a deaf or profoundly hearing- impaired person must learn to cope with a range of issues in their daily lives because of communication difficulties that are present. The relatives' lives are also positively influenced by the cochlear implant and this outcome can therefore be regarded as an important facet of the success of the cochlear implant. The results of research by Mo, Lindbæk and Harris (2005) indicated that the effect on the daily lives of significant others of the cochlear implant users can be regarded as positive. Improved relations within the family may often be visible and the cochlear implant user may feel that they are less of a burden to their family (Mo, Lindbæk & Harris, 2005).

The cochlear implant can therefore have a much wider impact than merely improving the hearing and the quality of life of the implantee (Schoeman & Fourie, 2004). The family dynamics in the cochlear implant user's home may contribute to the psychological outcomes experienced by the LIPD cochlear implant user.

2.2 Communication-related outcomes of a cochlear implant

Cochlear implants provide benefits not only in terms of sound awareness, speech recognition and communication skills, but also in various psychological domains (Bai & Stephens, 2005). The outcomes for postlingually deafened adults suggest that enhanced achievements in hearing, speech, and language are followed by benefits in terms of enhanced educational attainments, greater social versatility and robustness, and increased quality of life. These outcomes may flow over in long-term benefits, which include greater social independence and overall quality of life in adulthood (Sandeson & Nash, 2001). The cascade of outcomes for postlingually deafened adults is illustrated in Figure 2.2:

Enhanced auditory receptive skills

↓

Useful levels of ability in spoken language

↓

Enhanced social versatility and robustness

↓

Enhanced educational qualifications

↓

Enhanced opportunities in employment and further education

↓

Enhanced social independence and quality of life in adulthood

Figure 2.2: Cascade of outcomes expected when using a cochlear implant (Adapted from Sanderson & Nash, 2001).

According to Tyler and Tye-Murray (1991), cochlear implants have an enormous impact on the lives of thousands of postlingually deafened adults and recipients derive substantial benefit from this type of rehabilitative device, especially when they use it in conjunction with speech-reading (Eddington, 1995). In order to determine the success of cochlear implantation in LIPD adults, these same outcomes could be used as criteria.

It is therefore important to determine both self-reported and objective advantages and disadvantages of cochlear implant use in prelingually deafened adults. In this way a holistic view of this specific population group functioning with a cochlear implant can be established (Zwolan, Kileny & Telian, 1996).

2.2.1 Auditory Outcomes

Successful cochlear implant users experience a wide range of auditory benefits, and the area where use of a cochlear implant seems to provide the most benefit is in speech perception. Substantial improvements in word and sentence recognition, both in quiet and noisy conditions, are evident for postlingually deafened persons following implant activation (Bassim et al., 2005). Most cochlear implant users achieve auditory-only word recognition and communicate effectively when auditory cues are combined with speech-reading. The highest functioning adult recipients can converse fluently without speech-reading cues (Kirk, 2000), as was previously mentioned. Awareness and recognition of everyday environmental sounds and listening to music are also described as advantages of a cochlear implant (Tyler & Kelsay, 1990).

Cochlear implant users' ability to perceive sounds around them provide them with an environment that is more predictable. They connsequently feel safer and more at ease in their environment, especially in social situations. Improvements in all aspects of lifestyle are reported, including social interactions with family and other individuals. Postlingually deafened, successful cochlear implant users report benefits like reduction in the sense of isolation, a restoration of confidence, an improvement in speech-reading, and being able to hear warning sounds (Tyler & Kelsay, 1990). These improvements in performance may transform into a return to meaningful employment, improved social interactions, and enhanced self-esteem (Bassim et al., 2005). It is therefore considered a realistic expectation that positive short-term outcomes in the recipient's auditory receptive skills will develop into a cascade of medium and long-term outcomes in terms of his / her social independence and quality of life (Sanderson & Nash, 2001).

Auditory receptive skills, especially in relation to speech perception, are the area where cochlear implants provide the most benefit (Tyler & Kelsay, 1990). Cochlear implantation has a profound impact on hearing and speech recognition in the postlingually deafened population and enhanced auditory receptive skills are a generally accepted result of the cochlear implantation (NIH, 1995; Summerfield & Marshall, 2001).

Although great individual differences in the outcomes of a cochlear implant are noted (Wooi Teoh,Pisoni & Miyamoto, 2004), prelingually deafened adults tend to demonstrate smaller improvement in auditory and speech recognition related domains than postlingually deafened adults (Dowell, 2005). The outcomes of late-implanted prelingually deafened adults encompass a wide range and individual differences occur, especially as the period of pre-implant deafness increases. The outcomes will therefore be more uncertain than for those cochlear implant users who have a shorter term of deafness, as is the case in postlingually deafened adults (Waltzman, Roland & Cohen, 2002). The audiological, speech, and language outcomes of prelingually deafened adults are therefore related to the duration of auditory deprivation before implantation as well as the age of implantation. Due to the length of deafness in prelingually deafened adult individuals and the fact that implantation takes place after the age of 12 years (the years before the age of 12 years is regarded as the sensitive period for cochlear implantation), as well as the individual variability in outcomes, the prognosis for successful cochlear implantation is poorer than for postlingually deafened adults (Wooi Teoh,Pisoni & Miyamoto, 200; Waltzman, Roland & Cohen, 2002). The age of implantation has a significant impact on postimplant outcomes. Individuals who received an implant at an early age consistently have better outcomes than individuals who received implants at an older age. Adults with long-term prelingual deafness and later implantation derived the poorest benefits from their implant (Wooi Teoh, Pisone & Miyamoto, 2004). Receiving a cochlear implant at a younger age predicts superior post-implantation outcomes, and the opposite is expected for a late implantation (Moody-Antonio et al., 2005).

The cochlear implant only partially reproduces the coding of sound, and learning to use the perceptual information provided by the cochlear implant depends in part on the plasticity of the response in the central auditory nervous system (Clark, 2003). A sensory-neural hearing loss, such as the loss experienced by cochlear implant users, may be a result of degeneration of, damage to, or the failure to develop the sensitive transducer hair cells in the cochlea. The sensory hair cells do not regenerate, with the consequence that the hearing loss is permanent. The cessation of afferent inputs to the auditory system then leads to a series of predictable pathological changes along the entire auditory pathway (Wooi Teah et al., 2004), both peripheral and central. Prelingually deafened adults (whose onset of profound hearing impairment occurred prior to the normal development of auditory, speech, and language skills) had a lack of auditory input from early in life and this severely affects the intelligibility of their speech and their level of language competence. This long-term sound deprivation might also have caused morphological and physiological changes in the neural structure of the auditory pathway (Tong, Busby & Clark, 1988). These deafness-induced changes along the entire auditory pathway, which include the degeneration of the auditory nerve, the alteration of synaptic structures in the midbrain, and the failure to establish appropriate intra- cortical projections in the auditory cortex, all contribute to the gradual deterioration of auditory performance with increasing duration of auditory deprivation (Wooi Teoh et al., 2004).

Postlingually deafened adults, on the other hand, incurred the hearing loss after the acquisition of normal speech and language (Read, 1991). Due to the shorter period of time between incurring deafness and receiving an implant, there is a possibility that for these postlingually deafened cochlear implant users survival of auditory nerve fibers, memory of sound, and cortical flexibility to interpret novel sensation, are better established (Summerfield & Marshall, 1995). It can be concluded that the psychophysical properties of the hearing sensation produced by a cochlear implant in prelingually deafened users, and consequently the outcomes of cochlear implant use, are likely to be different from those produced by the same device in postlingual cochlear implant users. The late-implanted prelingually deafened adult's ability to use the new electrically coded speech information for perception and production differs from the use of the same information by late-implanted postlingually deafened adults (Busby et al., 1991).

This observation has lead to the general perception that late-implanted prelingually deafened adults receive only minimal benefit from a cochlear implant. The main disadvantage of implanting these prelingually deafened adults is that they do not show significant improvement in open-set speech recognition and perception and these are particularly disturbing when contrasted with the improved performance of postlingually deafened adults (Zwolan, Kileny & Telian, 1996). This has become the main reason for the great controversy about the appropriateness of implanting prelingually affected adult individuals with a cochlear implant at a later stage. Observations in this regard have led to the general perception that LIPD adults receive only minimal benefit from a cochlear implant. The main disadvantage of implanting LIPD adults is that they do not show significant improvement in open-set speech recognition and perception. Their lack of progress is particularly disturbing when contrasted with the improved performance of postlingually deafened adults (Zwolan, Kileny & Telian, 1996). It has also fueled the controversy surrounding the appropriateness of implanting LIPD adult individuals with a cochlear implant. It is in particular the benefits that a cochlear implant has to offer prelingually deafened adults who receive their implant later in life, that are situated at the center of this controversy.

Prelingually deafened individuals who receive cochlear implants as adults cannot understand speech by audition alone due to the morphological and physiological differences in the neural structures of the auditory pathway (Wooi Teoh, Pisoni & Miyamoto, 2004). These individuals often are handicapped in world, social, and linguistic knowledge, as a result of profound deafness during their language-learning years. Their limited experience and poor or no skills development in these areas cause additional difficulty in obtaining information from incomplete acoustic and speech-reading cues (Skinner et al., 1992). Relatively little research regarding the outcomes of this specific population exists, but nevertheless, the lack of significant advantages in cochlear implant use in this population are described in the literature (Skinner et al., 1992; Moody-Antonio et al., 2005). Some researchers find that LIPD individuals experience the value of speech information that they receive as less significant (Zwolan, Kileny & Telian, 1996). They must often compensate for the lack of auditory information by means of using written and / or manual communication, because they have difficulty in adjusting to the new auditory input via the cochlear implant and cannot make adequate use of this auditory signal, mostly due to ineffective speech reception abilities and limited language abilities (Zwolan, Kileny & Telian, 1996: 198; Tong, Busby & Clark, 1988: 951). More subjectively, they experience unpleasant sound sensations and facial nerve stimulation (Zwolan, Kileny & Telian, 1996; Skinner et al., 1992) and this can therefore be described as a definite disadvantage of the implantation. Prelingually deafened adults with long-term deafness also reach their performance plateaus significantly earlier than cochlear implant users who receive implants during their early childhood and this may influence the significance of sustained outcomes. As previously mentioned, prelingually deafened adult cochlear implant users reportedly reach their plateau within 6 months to 1 year whereas postlingually deafened cochlear implant users experience continuing improvement of auditory skills for 3 to 5 years after implantation (Wooi Teoh, Pisoni & Miyamoto, 2004).

Although expectations with regard to benefits of late implantation may in general be low for prelingually deafened adults, great differences in individual outcomes are also reported in this particular population group and some individuals may obtain substantial benefit from their implants (Sarant et al., 1994). Late-implanted adolescents may have relatively poor speech recognition skills, yet they often report that they experience satisfaction (Kos, Deriaz, Guyot & Pelizzone, 2009). It is therefore important not to take speech recognition and auditory-alone performances exclusively into consideration in determining the final benefit of the cochlear implant. It seems relevant to view the benefit that a cochlear implant may have for a prelingually affected adult cochlear implant recipient from a broader perspective.

One benefit not directly related to speech is that there is a marked improvement in their ability to detect or register sound via the cochlear implant, especially environmental sounds. These individuals are able to detect the full range of sounds from low to high pitches and can, within this range, differentiate between the pitches of different sounds according to what is regarded as normal hearing range (Skinner et al., 1992). Although open-set speech recognition is not necessarily attained, it is nonetheless, important to note that LIPD adults often receive more speech information through the cochlear implant than through hearing aids (Sarant et al., 1994). The LIPD population also report that they find music to be particularly enjoyable with their cochlear implant. Their speech-reading skills also improved when using the cochlear implant, with the results that communication interaction is more successful. The integration of auditory and visual cues enhances speech perception, especially under difficult listening conditions (Moody-Antonio et al., 2005) and improves everyday communication (Busby et al., 1991).

Although members of this population differ in their ability to speech-read and to use the auditory information provided by the cochlear implant, all communicate more easily in everyday life (Skinner et al., 1992) and in research surveys their subjective assessment regarding auditory comprehension in day-to-day conversations was found to be positive (Watlzman & Cohen, 1999).

2.2.2 Language Outcomes

Language is the basis for communication between people (Clark, 2003) and in essence, it links the adult cochlear implant user with other normal-hearing people (Summerfield & Marshall, 2001). Fewer hearing difficulties and improved communication, both benefits of cochlear implant use, are significantly associated with improved quality of life (Bai & Stephens, 2005). In the case of postlingually deafened adults, spoken language (before implantation) is seriously compromised due to hearing loss and useful levels of spoken language are decreased. The onset of a profound or total hearing loss after the acquisition of normal speech and language results in problems with communication. However, postlingually deafened cochlear implant users indicated that with the implant they feel more confident in social situations, including initiating conversation and speaking. They report feeling more accepted by others and no longer isolated socially (Tyler & Kelsay, 1990). Enhanced social versatility and robustness can be obtained. Cochlear implants, therefore, contribute to improvements in abilities of communication, which includes language skills (Bai & Stephens, 2005).

It is widely recognized that the expressive speech and language of people who are congenitally profoundly hearing impaired are likely to be more severely affected than in the case of people who developed normal speech and language before they became deaf (Read, 1991). Delayed diagnosis will isolate a deaf child from early linguistic experiences and impact negatively on normal language development. If the onset of deafness was prelingual, implantation after two years of age will not prevent language delay with respect to language structure, vocabulary, and the creative use of language (Sanderson & Nash, 2001). It has been shown that substantial delays in receptive and expressive language can occur in prelingually deafened adults due to the early onset deafness (Dawson, Blamey, Dettman, Barker & Clark, 1995). The lack of early auditory input severely affects their level of language competence (Tong, Busby & Clark, 1988). Even though LIPD adults experience benefits from the cochlear implant, objective assessment of language will show that they do not reach a high level of language comprehension (Manrique et al., 1994). It was determined by Dawson et al. (1995) that most LIPD adults demonstrated language ages well below their chronological ages at all pre- and postoperative evaluations, although postoperative performances exceeded preoperative performance. The gain obtained with cochlear implants in this population, however, is not sufficient to help these cochlear implant users convert their mode of communication from visual to oral mode only (Kos, Deriaz, Guyot & Pelizzone, 2009). Cochlear implants may facilitate the acquisition or expansion of receptive vocabulary in this population, but not significantly.

Literature has indicated that prelingually affected, late implanted adult cochlear implant users often report an increase in their use of auditory/oral communication after the implant and the improvement extends into both their receptive and expressive communication skills (Zwolan, Kileny & Telian, 1996). The highest speech perception and language scores have been obtained with LIPD cochlear implant users who use oral speech and language as their sole mode of communication (Waltzman & Cohen, 1999). Factors such as language training in the educational setting, intelligence, and improvements in speech reading and reading skills may contribute to vocabulary growth. Improvement in speech perception further supports vocabulary growth experienced by cochlear implant users (Dawson et al., 1995).

Adequate hearing and the development of speech and language are essential for communicating in the hearing community. The restoration of the ability to hear and effective receptive and expressive language skills are of great importance (Clark, 2003).

2.2.3 Speech Intelligibility Outcomes

The onset of a profound hearing loss after the acquisition of normal speech and language often results in communication problems. The loss of auditory feedback to the deafened person's own speech production system may result in deterioration of speech intelligibility and production skills. The adult speech production control mechanism is well established and auditory feedback is not always essential. The onset of deafness in adults, therefore, does not usually interfere with the ability to speak, except that some deafened adults tend to shout owing to problems with monitoring the loudness of their voices. However, some adults retain excellent speech after being deaf for several years whilst others show marked deterioration after a short period of time.

The effect of cochlear implant use on the speech intelligibility of postlingually deafened adults is positive. Cochlear implant users show improvement in voice quality, intonation patterns, volume control, and intelligibility (Read, 1991). The remarkable improvements in speech intelligibility as is due to the fact that they are able to use the auditory feedback provided by their cochlear implant to improve the control of the nasal-oral balance of their speech (Sanderson & Nash, 2001). Researchers report that their ability to monitor their speech was noted and they experience improved pronunciation and control over their speech. The short-term goal of useful levels of ability in spoken language is therefore reached by means of implementing a cochlear implant (Summerfield & Marshall, 2001). The ability of LIPD adults to use the new speech information provided by the implant, specifically for speech intelligibility, could differ from the use of the same information by postlingually deafened adults. The LIPD adults' speech is expected to be generally poorer than that of the postlingually deafened cochlear implant users (Busby et al., 1991).

LIPD adults present with speech errors which influence their speech intelligibility negatively (Dawson, Blamey, Dettman, Rowland, Barker, Tobey, Busby, Cowan & Clark, 1995). Consonant errors include substitutions, omissions, and distortions. Visible, front consonants are often substituted for less visible, back consonants, and substitutions by consonants of different manner and/or place of articulation occur. Errors in voicing also may be present in their speech. Consonant blends are frequently reduced to a single consonant (consonant cluster reduction). Vowel production is characterized by a higher proportion of errors for sounds requiring high or mid-tongue heights than for sounds with low-tongue heights. Front vowels are produced less accurately than back vowels (Dawson et al., 1995; Busby et al., 1991). These speech errors are most likely due to the inability to utilise auditory feedback, and influence speech intelligibility.

Improvement in objectively assessed speech production and intelligibility in LIPD adults was, however, recorded by Busby et al. (1991). The improvement in auditory abilities can lead to the improvement of their speech production skills

(Zwolan, Kileny & Telian, 1996; Skinner et al., 1992; Waltzman, Cohen & Shapiro, 1992). They present with more abundant and more significant improvements on high context intelligibility sentences than on low context sentences, and gains in the accuracy for certain consonant groups have also been observed. Dawson et al. (1995) found that, in general LIPD adults' speech intelligibility was higher postoperatively than preoperatively.

According to Zwolan, Kileny and Telian (1996), the LIPD adults in their study responded positively in terms of their self-reported speech intelligibility. Most indicated an increase in their use of oral communication methods after the implant and they also indicated that the cochlear implant had improved their speech. The sustained use of the cochlear implant may also be a good indicator of subjectively perceived benefit, which includes the perception of improved speech intelligibility (Moody-Antonio et al., 2005).

2.2.4 Quality of Life Outcomes

Hearing loss is not generally a life threatening disability and therefore the cochlear implant procedure itself has little direct impact on life expectancy. The cochlear implant rather improves the user's quality of life, through restoring or allowing acquisition of auditory skills, improving articulation, and enhancing the development of language comprehension (Clark, 2003).

Cochlear implants have, in addition to the primary objective of facilitating oral communication, several other quality of life attributes. Improved self-esteem, better performance of daily activities, and improvements in social interactions have been reported (Summerfield & Marshall, 2001). A cochlear implant enables adult users to have the best chance possible to reach their potential in a hearing world, and the benefit to society and national economics are significant. The combination of implantation, appropriate rehabilitation, and emphasis on auditory and oral communication skills improves the quality of life for the deafened individual. The individual is able to contribute to society, both economically and functionally, which makes the process cost-effective and favourably comparative with other medical interventions (Summerfield & Marshall, 2001).

A quality of life study by Mo, Lindbæk and Harris (2005) indicated that cochlear implant users achieved significant improvements in the ability to communicate, were less isolated, had less feeling of being a burden, and had better relations with their family members and friends compared to before the use of the cochlear implant. The improved communication has a broad effect on the user's daily life. The improvement in interpersonal communication skills and social confidence are important quality of life outcomes. Cochlear implants have a positive impact on quality of life among profoundly deaf adults, including both postlingually and prelingually deafened individuals. In the Mo, Lindbæk and Harris (2005) study, 65.8% of postlingually deafened adults and 50% of prelingually deafened cochlear implant users reported that their quality of life was much better one year after cochlear implantation.

Deaf adults who did not attend mainstream elementary schools are less likely to pursue secondary education and are more likely to be under-employed or unemployed. Accordingly, deafened people traditionally have had fewer educational qualifications and were found to be less likely to be in paid employment when compared with people without a hearing disability. Communication problems in combination with hearing loss are the primary variables affecting successful job search, placement, and retention in a negative manner. Cochlear implants have, however, enabled postlingually deafened individuals to continue their educational studies and pursue employment, or remain employed in an occupation of their choice. This improved access to education for cochlear implant users may possibly have overflow effects such as improved socioeconomic status and wellbeing (Summerfield & Marshall, 2001). A significant majority of cochlear implant users indicated increased job satisfaction and feelings of success as a result of their improved communication skills. Other work-related benefits were also reported, such as enhanced pay, increased activities and duties, enhanced training opportunities, and better employer-employee relationships (Sanderson & Nash, 2001). Occupational progress is therefore experienced due to the use of a cochlear implant and implant users have improved self-esteem.

The advantages of a cochlear implant for these individuals further extend into more social satisfaction and overall improvement in quality of life. A feeling of increased independence is often experienced and they are more social and less lonely as a result of receiving the implant. Cochlear implant users, both postlingually and prelingually deafened adults, reported that they felt more confident in social situations, including initiating conversations and speaking. These individuals feel more accepted by others. They also felt safer or more at ease in everyday situations and also stated that they were happier (Tyler & Kelsay, 1990).

The LIPD adults surveyed by Zwolan and colleagues (Zwolan, Kileny & Telian, 1996) reported specifically that they were satisfied with their device and some of the significantly positively regarded aspects were related to improved quality of life. With reference to the cascades of outcomes for a cochlear implant, according to Sanderson & Nash (2001), the LIPD adults showed the same enhanced social independence and quality of life as the postlingually deafened cochlear implant users.

2.3 Conclusion

Due to the varying degrees of benefits experienced by prelingually deafened adults, late cochlear implantation is cautiously warranted by cochlear implant teams internationally. Cochlear implant teams continue to experience challenges in deciding on appropriate candidacy for this group (Waltzman, Roland & Cohen, 2002). This is also the case with the cochlear implant programmes in South Africa (Van Dijk, C., Personal Communication, January 2006).

The general problem in the South African context is that the advantages, limitations, and disadvantages of cochlear implantation in LIPD adults are as yet unexplored, especially in terms of communication-related outcomes. The lack of scientifically based observations and information is currently interfering with and complicating the decision-making process by cochlear implant teams in terms of candidacy guidelines for this specific population. It seems that there is a need for scientifically researched and described information regarding the communication-related outcomes (objectively assessed as well as self-reported) of a late cochlear implantation in prelingually deafened adults. The investigation and description of implant outcomes for this particular group and knowledge about their hearing history, speech, and language development and use of residual hearing will make evidence-based recommendations possible. These recommendations will not only inform the cochlear implant team about the subjective and objective outcomes of a cochlear implant for these individuals, but will provide guidelines for informed decision making regarding a variety of issues to be considered including the ultimate cost-effectiveness of the cochlear implant for this population. It may also discourage implantation of individuals who are essentially inappropriate candidates and might decrease the number of patients who become non-users (Zwolan, Kileny & Telian, 1996).

This chapter aimed to describe and discuss predictive factors of cochlear implant use and the outcomes of cochlear implants in prelingually deafened adults. The study uses this framework to guide investigation and determination of the communication-related outcomes of late-implanted prelingually deafened adults, as well as the interpretation of the research results.

CHAPTER THREE

METHODOLOGY

3.1 Research aims

3.1.1 Main aim

The main aim of this research was to determine the self-reported and objectively assessed communication-related outcomes of cochlear implant use for late-implanted prelingually deafened (LIPD) adults.

The following sub-aims were formulated in order to investigate the variety of facets summarised in the main aim.

3.1.2 Sub-aims

- To determine the self-reported and objectively assessed audiological outcomes of cochlear implant use for LIPD adults.
- To determine the self-reported and objectively assessed communication-related language outcomes of cochlear implant use for LIPD adults.
- To determine the self-reported and objectively assessed communication-related speech outcomes of cochlear implant use for LIPD adults.
- To determine the self-reported communication-related quality of life outcomes of cochlear implant use for LIPD adults.

3.2 Research design

A research design is a plan or blueprint of how one intends to conduct the research and it focuses on the end product by formulating a research problem as a point of departure (Mouton, 2001). The current study is an example of applied research. Within the context of applied research a multiple single case study was selected. The researcher collected extensive data from the LIPD adult individuals on which the investigation was focused. The multiple case studies enabled the researcher to learn more about the little known or poorly understood communication-related outcomes of this specific cochlear implant user population

(Leedy & Ormrod, 2005). The research approach that best suited the purpose of the study was a combined qualitative-quantitative approach, with a cross-sectional data collection technique where the sample data was collected at a particular point in time for purposes of describing the variables and their patterns of distribution. The variables in question were the different outcomes regarding cochlear implant use in prelingually deafened adults (Maxwell & Satake, 2006).

The purpose of qualitative research is to answer questions about the complex nature of phenomena, often with the purpose of describing and understanding the phenomena from the participants' point of view (Leedy & Ormrod, 2005). In the current study, the purpose was to determine the self-perceived communication-related outcomes of a cochlear implant in the prelingually deafened population in terms of language and speech abilities as well as their quality of life. The nature of the data collected in this section of the study was a collection of descriptions or reports of experiences by the participants.

To support the qualitative information obtained from the participants, quantitative explorative research was used to further describe the outcomes of the cochlear implant users. Quantitative research aims to answer questions about relationships among measured variables with the purpose of explaining, predicting, and / or controlling phenomena (Leedy & Ormrod, 2005). In the current study, the quantitative section aimed to describe and interpret objectively assessed communication-related outcomes of a cochlear implant in the prelingually deafened population in terms of audiological performance, language, and speech intelligibility. The nature of the data collected in this section was numerical information that allowed for statistical procedures

The process of triangulation enables a researcher to compare data from several different types of sources that could provide insights about the same events or relationship (De Vos, Strydom, Fouché & Delport, 2002). In this study, the communication-related outcomes of a cochlear implant for prelingually deafened adults were measured in more than one way (qualitatively and quantitatively) in order to observe all the relevant aspects (De Vos et al., 2002). The objectively assessed outcomes, according to the literature, are often different from the self-reported outcomes for these specific individuals. The use of a cochlear implant may not objectively have the success that is perceived by postlingually deafened adults, but the prelingually deafened cochlear implant users may experience an improvement in their maintenance of auditory skills and their overall communication and quality of life (Zwolan, Kileny & Telian, 1996; Waltzman, Cohen & Shapiro, 1992 & Wooi Teoh, Pisoni & Miyamoto, 2004). The use of multiple methods to obtain different perspectives of the research question therefore enhanced the value of the answer (Maxwell & Satake, 2006).

In accordance with the research plan outlined above, the investigation was conducted in two phases:

- A semi-structured interview was used. A schedule was developed for the purpose of obtaining information regarding the self-reported outcomes of a cochlear implant in prelingually deafened adults.
- Secondly, a test battery of measurements was utilised in order to obtain specific objective measurements of the audiological, language, and speech intelligibility outcomes of a cochlear implant for the LIPD population. This data allowed the researcher to determine their communication-related abilities objectively (De Vos et al., 2002).

3.3 Participants

Participant selection criteria are an important part of the preparation of the study and ensure the use of appropriate participants. The participant selection criteria were as follows.

3.3.1 Criteria for participant selection:

Selection criteria were established in order to select appropriate participants that conform to the requirements of the study.

Table 3.1 Selection criteria for participants.

Criteria	Justification
Participants had to be clients of the Pretoria Cochlear Implant Programme (PCIP) at the University of Pretoria.	To ensure uniformity between the participants exists and to ensure that information was easily available and obtainable for the researcher, who has access to the PCIP.
Participants had to be prelingually	The aim of the study was to investigate the communication-

severely to profoundly deafened (a 75 dB HL or more hearing loss). A person who has a prelingual hearing loss incurred the loss before the acquisition of spoken language (Tye-Murray, 2004).	related outcomes of cochlear implants for prelingually deafened adults. The onset of deafness, whether congenital or adventitious was therefore required to have been before the development of speech and language (Nicolosi, Harryman & Kresheck, 1996).
Participants had to be 16 years of age or older at the time of the research.	The purpose of the study was to determine the experiences of adult language users. Persons from the age of 16 years and older are regarded as adult language users and communicators (Owens, 2001) and therefore participants from the age of 16 years and older were included.
Participants had to have undergone the implantation at least ten years after the hearing loss was diagnosed. The participant must therefore be a late-implanted cochlear implant user.	The duration of hearing loss before implantation has a significant impact on post-implant outcomes. To ensure that prelingually deafened adults were targeted, the participants required to have experienced at least ten years of auditory deprivation (with or without the use of a hearing aid) (Wooi Teoh, Pisoni & Miyamoto, 2004).
Participants had to have been using their cochlear implant for a period for at least six months.	The participants had to be accustomed to wearing the device and adapted to using it. According to the literature, this group of cochlear implant users is typically only dedicated to the mapping and rehabilitation up until six months and reaches their performance plateaux at this time (Wooi Teoh, Pisoni & Miyamoto, 2004).
Participants had to be proficient in either English or Afrikaans.	The participants had to be able to complete the semi-structured interview as well as to execute the required test battery. The majority of implanted clients of the PCIP are either English or Afrikaans. In addition, the researcher is only proficient in these two languages.

The following criteria were not regarded as selection criteria:

Table 3.2: Aspects not to be considered as selection criteria for participants.

Aspect not to be considered	Reason for omission
Unilateral cochlear implant or bilateral cochlear implants.	Unilateral versus bilateral implants has very little effect on the acquisition of communication-related outcomes. Bilateral implantation mainly improves localization and discrimination abilities in noise with approximately 8% (Müller, Schön & Helms, 2002)
A specific type (ear level versus body worn) and model (Esprit 3G, Sprint, Freedom, etc.) of speech	The specific type (ear level versus body worn) and model (Esprit 3G, Sprint, Freedom, etc) of speech processor do not greatly influence the outcomes of a cochlear implant

processor.	(Nauta, L., Personal Communication, October 2006).
A specific implant model (e.g. N24, Freedom).	The specific implant model (e.g. N24, Freedom) does not greatly influence the outcomes of a cochlear implant (Nauta, L., Personal Communication, October 2006).
Processing strategies (CIS, ACE or SPEAK).	The literature states that patient characteristics are probably the major contributing factors that are responsible for observed outcomes in prelingually deafened adults, rather than different processing strategies (Wooi Teoh, Pisoni & Myamoto, 2004). The use of a specific processing strategy did therefore not exclude or include a participant in the study.

The aspects listed in Table 2.3 were not considered as selection criteria due to the negligible impact of the aspects on the variables under investigation.

3.3.2 Sample size and selection procedure:

The sample size must be sufficient to provide enough data to answer the research question (McMillan & Schumacher, 2001). Due to the small population of prelingually deafened adults in the Pretoria Cochlear Implant Programme (n=9), all participants who comply with the selection criteria were included as participants in this study. The small number of prelingually deafened adults implanted with a cochlear implant in the South African context and specifically in the Pretoria Cochlear Implant Programme is due to the world trend or belief until recently that prelingually deafened adults receive only minimal benefit from the cochlear implant. Therefore, prelingually deafened adults are only implanted if resources are available and eventually only ten percent of the caseload is recommended for implantation (Nauta & Wiegman, 2005; Zwolan, Kileny & Telian, 1996).

This study was concerned with detail and in-depth analysis, and purposeful convenient sampling was used to select the participants. Purposeful convenient sampling involves the selecting of information-rich cases for in-depth study when one wants to understand something about those cases without needing or desiring to generalize to all possible similar cases (McMillan & Schumacher, 2001). On the grounds of logistic motives and accessibility to the PCIP, the researcher conveniently used the clients of the PCIP. This sample is an example of non-probability sampling, which could be described as a process of constant comparison between the individuals or topics studied due to the importance of understanding all aspects of the specific research topic (Strydom & Delport, 2002).

The name list of all cochlear implant users of the Pretoria Cochlear Implant Programme was used to aid the researcher in the selection of possible participants. All the clients who were prelingually deafened and 16 years of age or older included in the Pretoria Cochlear Implant Programme, were selected with the assistance of the coordinator of the programme.

3.3.3 Description of the sample

The profile of the participants is displayed in Table 3.3. The information was obtained from data acquired from the coordinator of the programme and during the interview.

Table 3.3: Description of the sample

Number of participants	7
Age	21 years to 36 years
Gender	Male and Female
Mode of communication	Oral, manual, and total communication
Type of implant	Nucleus 24 Contour, Nucleus 24 with Contour Advance, Nucleus 24 Double Array, Freedom with Contour Advance
Type of speech processor	Esprit 3G and Freedom
Unilateral/Bilateral	7 Unilateral implants
Duration of profound hearing loss (prior to implantation)	10 years to 35 years
Age of implantation	12 years to 35 years
Duration of device use	6 months to 9 years
First Language	Afrikaans
Number of maps per year	Two or more maps

3.4 Ethical Considerations

The use of human beings as participants in social sciences studies brings unique ethical problems to the fore that would not be relevant in the pure, clinical laboratory settings of the natural sciences. Ethical guidelines serve as standards and as the basis on which each researcher in the field of social sciences ought to evaluate his / her own conduct (De Vos et al., 2002). Ethical issues in research are described in four categories, namely protection against harm, informed consent, confidentiality and anonymity, and honesty with professional colleagues (Leedy & Ormrod, 2005; Babbie & Mouton, 2001). The literature supports and emphasizes the importance of ethical conduct in research.

The research proposal aa well as the proposed questionnaire and objective test battery were submitted to the Research Committee of the Department of Communication Pathology, the Research and Ethics Committee of the Faculty of Humanities, University of Pretoria, and to the Head of the Pretoria Cochlear Implant Programme (PCIP). The Head Ear, Nose and Throat Specialist of the programme gave permission for the researcher to collect and use the participants' data for research purposes. The conditions of both the Head of the PCIP and the Research and Ethics Committee were taken into account before the study was undertaken (see letters of approval in Appendix A and B).

Consent was then obtained from all the adult participants, and in the case of young adult participants from the legal guardians of the participants and from the young adults themselves. The ethical principle of informed consent stipulates that the participant and significant others should be informed about the nature of the study to be conducted and then given the choice of either participating or not participating (Leedy & Ormrod, 2005). This principle was incorporated into the study by means of providing a letter of informed consent (see Appendix C) with a full, clear explanation of the procedures in which the participants took part. The letter of informed consent was completed by the adult participants (21 years and older) and the parents of the young adult participants. A letter of assent was completed by the young adult participants (16 years to 20 years 11 months) and both the informed consent and assent served as a contract between the researcher and the participant. Confidentiality was assured in that the researcher made an active attempt to remove any element that might indicate the participants' identities (Mouton, 2001). The personal identity of each participant was concealed and only anonymous quotations were published in the results. The letter of consent indicated that participation in the research was voluntary and that it could be terminated at any time. Ethical guidelines consequently formed the foundation of this research project.

3.5 Data Collection Instruments and Apparatus

Data collection instruments as well as various items of apparatus were employed in order to obtain the information required from the participants.

3.5.1 Data collection instruments

A semi-structured interview and various other formal test instruments were the chosen methods for data collection in this study and are described in the following discussion.

3.5.1.1 Interview Schedule (See Appendix D)

The design of the interview schedule is described in the following section.

Purpose of the semi-structured interview:

The purpose of the semi-structured interview was to collect information regarding the self-reported outcomes of the LIPD adults (See Appendix D).

Justification of the semi-structured interview:

A semi-structured interview is used to gain a detailed picture of a participant's beliefs, perceptions, or accounts of a particular topic (De Vos et al., 2002) and in the case of this study it was used to determine the self-reported outcomes of cochlear implants for LIPD adults.

Interviews can yield a great deal of qualitative information and the researcher can ask questions related to any topic. A structured face-to-face interview has the distinct advantage of enabling the researcher to establish rapport with the participants and therefore gain their cooperation. It also gives both the researcher and the participant more flexibility (De Vos, et al., 2002). These types of interviews yield the highest response rate. Personal interviews also allowed the researcher to clarify ambiguous answers and, when appropriate, to seek follow-up information regarding issues that emerge in the interview (De Vos et al., 2002).

Due to the small sample size of this study, structured interviews could be used regardless of the time needed to complete the interview (Leedy & Ormrod, 2005).

Interviewing involves much more, however, than just asking questions. The limitations of an interview are firstly that it involves personal interaction and cooperation is therefore essential. Participants may be unwilling to share information, and the researcher may ask questions that do not evoke the desired responses from the participants (De Vos, et al., 2002). Interviewer bias is also greatest in face-to-face interviews. The body language, tone of voice, and wording of questions of the interviewer may affect the respondent (Neuman, 2006).

Certain techniques and guidelines were followed in order to minimize the possible pitfalls of the semi-structured interview. An effective interview was ensured in the following way:

- A pilot study was conducted in order to determine if interview questions were clear and if the interviewer's demeanour was appropriate.
- During each interview in the main study, the participants did most of the talking. The researcher limited her own remarks and listened more to the information provided by the participants.
- Single clear questions were asked, but when necessary, the researcher explained the question to ensure that no misunderstanding could take place.
- Rapport was established and maintained. The researcher wanted to gain information from the participants without revealing her own perspectives. The researcher therefore maintained rapport and a general feeling of trust and closeness, by showing interest by means of body language and neutral encouragement.
- The participants also had the opportunity to express themselves in their own way, without the researcher guiding them in what to say.

The advantages of the structured interview were held to exceed the disadvantages and since the techniques and guidelines outlined above were followed, this data collection instrument could be implemented (De Vos et al., 2002).

Content and compilation of the structured interview

A questionnaire written to guide interviews is called an interview schedule or guide. This provides the researcher with a set of predetermined questions that are used as an appropriate instrument to engage the participant (De Vos et al., 2002). It is important that these questions should be related to the research question and overall research problem (Leedy & Ormrod, 2005). The interview schedule content was compiled according to each sub-aim using various sources from diverse fields. The instrument firstly drew questions from the questionnaire used by Zwolan, Kileny and Telian (1996) to determine the self-report of cochlear implant use and satisfaction by LIPD adults. Other questionnaires used at the Department of Communication Pathology, University of Pretoria and the PCIP also contributed to the compilation of the interview schedule. The questions and justification of the questions were influenced by various sources in the field of cochlear implantations (Clark, 2001), especially sources with regard to late-implanted, prelingually deafened adults (Zwolan, Kileny & Telian, 1996). The interview schedule's structure was supported and confirmed by investigating and using various sources of research, qualitative research and social research (Leedy & Ormrod, 2005; De Vos et al., 2002; Babbie & Mouton, 2001).

In a semi-structured interview, the researcher may follow the standard questions with one or more individually tailored questions to gain clarification or probe a person's reasoning. The interview was reasonably lengthy (approximately 30 minutes) and therefore attempts were mostly made to present questions in a simple and easy manner making use of close-ended questions (Leedy & Ormrod, 2005). The use of close-ended questions give rise to better understanding of the meaning of the questions and questions can therefore be answered within the same framework (De Vos et al., 2002). Interview questions should also encourage the participants to talk about a topic (Leedy & Ormrod, 2005) and therefore an open-ended question was posed at the end of each section of the interview. The open-ended questions were used to explore a broader range or view on the specific topic and to gain in-depth understanding of the participants' perspectives (Maxwell & Satake, 2006). A logical flow and order of questions were used, with questions grouped under each section according to the sub-aims. Unambiguous language and brief, clear instructions were utilised and where needed, the terminology was clarified. The use of simple, uncomplicated language was especially relevant as prelingually deafened adults are known to have language delays (Zwolan, Kileny & Telian, 1996). The pilot study was conducted to provide an estimate of the time taken to complete the interview and to evaluate the interviewing instrument.

Structure of the interview schedule:

The interview schedule consisted of 12 pages and the duration in time to complete the interview was approximately 30 minutes. The interview schedule was divided into five sections. Section A consisted of 22 questions, section B of 11 questions and section C of eight questions. Section D consisted of five questions and section E of 13 questions.

The first section of the interview schedule involved *biographical information* regarding the LIPD adult's auditory, speech, and language history, as well as general information. The general section questions were used for identifying information, such as names, age, gender and language of the participants in order to provide an accurate description of this specific population (Van der Spuy, 2001). The participant's occupation and environment after work were also discussed, as well as the amount of communication required for both. The rest of section A was subdivided into three subheadings, namely information regarding auditory history, information regarding speech and language history, and information regarding the cochlear implant. The information obtained in this section was used to determine all defining factors and variables in the study (Bless & Higson-Smith, 1995). The questions in section A were presented to the participant, but responses were also verified through the use of the information file of the PCIP. Both closed-ended and open-ended questions were asked.

The next section (Section B) covered the *auditory outcomes* as experienced by the LIPD adults. The section was categorised according to three subsections, namely hearing, speech-reading and localization. Subsection one ("hearing") was further subdivided into three categories. First, hearing in everyday situations was examined, where the usefulness of the implant and the participant's ability to recognise environmental sounds were determined. Ability to hear speech was also examined, in terms of real-life speech situations, as well as over the telephone. Secondly, hearing at work / school / place of study was determined by means of evaluating the usefulness of the cochlear implant in certain work-related activities. Lastly, hearing in social situations was discussed and again the usefulness of the cochlear implant was explored. The speech-reading subsection focused on speech reading ability before and after cochlear implantation, as well as on the participant's ability to understand speech without speech-reading in certain speech acts. The last subsection secured information regarding localization skills and questions regarding the localization of environmental sounds and speech were asked. The section was concluded with an open-ended question regarding the participants' perception of their auditory functioning with the use of the cochlear implant.

The *language* and *communication outcomes* comprised the next section (Section C). This section was also categorised in three subsections. The first subsection focused on language and communication in everyday situations. Information regarding the participants' receptive and expressive language, as well as the use of gestures during communication was obtained. Language and communication at work / school / place of study was discussed in the next subsection and communication in work-related activities was examined. Language in social situations focused on social activities and how the cochlear implant influences these activities. An open-ended question was also used to conclude this section.

The *speech intelligibility outcomes* (Section D) were documented next and this section focused on describing the speech characteristics before and after the implantation. Questions regarding how other people experience their speech intelligibility were also included. An open-ended question was used to determine the participants' self-reported experience of a cochlear implant in terms of their speech.

The last section of the interview determined the participant's *quality of life outcomes* (Section E). Again this section was subdivided into three categories, namely quality of life in everyday situations, quality of life at work / school / place of study, and quality of life in social situations. In the first subsection, questions regarding their daily life, their independence, and their relationships with family members and partners were asked. The quality of their friendship with their deaf and hearing friends was evaluated as well. In the second subsection, their quality of work-related relationships, their performance at work and work satisfaction with the use of the cochlear implant were investigated. The last subsection focused on discussing their social activities, as well as self-confidence and self-consciousness when the cochlear implant is used. Their quality of life with the cochlear implant was discussed in more detail by closing this section with an open-ended question.

The majority of questions were presented as tables of options, where the participant was instructed to choose one or choose all applicable options. The researcher ticked the appropriate option on the interview schedule, as part of the documentation process. The English and Afrikaans interview schedule are included in Appendix D.

3.5.1.2 Materials for test battery

In the preparation phase of the research study, it was decided that both English and Afrikaans speaking participants would be selected and the test materials were prepared accordingly. During participant selection, however, it was established that only Afrikaans participants were available and therefore only the Afrikaans test materials will be discussed. The interview schedule was translated because the study is made available in English.

The following test battery instruments were used to determine each participant's auditory, language, speech intelligibility, and articulation skills:

- **Auditory skills:**

1. A standard audiogram as used by the Department of Communication Pathology at the University of Pretoria was used to record the pure tone and speech audiometry measurements, tympanometry, and otoscopic results (See Appendix E).
2. *Afrikaans Foneties gebalanseerde woordelys* (Laubscher & Tesner, 1966) (*Phonetically Balanced wordlist* by Egan, 1984) was used to determine the participant' speech discrimination abilities (See Appendix E).
3. The *Central Institute for the Deaf (CID) Everyday sentence list* (Davis & Silverman, 1970) in Afrikaans (Muller & De Stadler, 1987), was used to test

the participant's speech recognition at a sentence level (Katz, 2002) (See Appendix E).

- **Language skills:**

The score sheets of the following formal and functional language tests were completed by the researcher after the administration of the tests:

1. The *"Afrikaanse Reseptiewe Woordeskattoets"* (Buitendag, 1994) was used to determine the participant's receptive vocabulary (*"Peabody Picture Vocabulary Test"* (Dunn & Dunn, 1981)). See Appendix E.
2. A section of the *"Clinical Evaluation of Language Function"* (Wiig & Semel, 1980) translated in Afrikaans was used to determine the participant's expressive language abilities (See Appendix E).

- **Speech intelligibility and articulation skills:**

1. The *Speech Intelligibility Rating (SIR)* (Dyar, 2003) was used to assess the overall participant's speech intelligibility (See Appendix E).
2. The *"Afrikaanse Artikulasie Toets"* (Lotter, 1974) (*"The Goldman-Fristoe Articulation Test",* Goldman & Fristoe, 1969) determined the participant's articulation abilities (the specific pronunciation of speech sounds). See Appendix E.

Except for the *Speech Intelligibility Rating* scale, all the tests are formally standard tests which are routinely used to evaluate clients of the various cochlear implant programmes.

3.5.2 Data collection apparatus

- A **Welch Allyn pocketscope otoscope** enabled the researcher to administer the otoscopic examination. The otoscopic examination is part of the test battery and was used to refer any abnormalities.
- A **GSI-33 immittance meter** (calibrated in 2006/2007) was utilised to perform tympanometry. Although the cochlear implant bypasses the middle ear, the presence of middle ear pathology can possibly influence the participant's auditory outcomes (Clark, 2003). Therefore, tympanometry ensured that valid and reliable outcomes were assessed. The goal of this

measurement is to determine the middle ear functioning. Appropriately sized probes fitted according to each subject, were used.

- A **Grason-Stadler (GSI-61) audiometer** (calibrated in 2006/2007) was used to determine each participant's aided pure tone thresholds with the cochlear implant, speech discrimination, and speech in noise measurements.
- A **soundproof room** of the *Industrial Acoustic Corporation* is essential for accurate and reliable pure tone and speech measurements and was used to provide a sound-treated environment while testing (Bess & Humes, 1995).
- **Paper towels** and **Milton fluid** was used in order to sterilize the immittance probes and speculums of the otoscope before and after use.

3.6 Pilot study

A pilot study was conducted before the main study and is described below.

3.6.1 Aim of the pilot study

A pilot study is the process of pre-testing a measuring instrument or research design (Strydom, 2002). The aims of the pilot study are therefore to determine the feasibility of the research project and to make refinements as needed. In addition, the pilot study aimed to train the researcher in accurately and reliably administering the methods and procedures of the study as planned. The pilot study assessed the clarity and conciseness of the questions, as well as the time and effort needed to complete the interview (Maxwell & Satake, 2006; Leedy & Ormrod, 2001).

3.6.2. Participant of the pilot study

The participant for the pilot study was identified by the coordinator of the PCIP. Due to the small available size of the specific population, it was decided not to use one of the identified LIPD adults for the pilot study, as participation in the pilot study would exclude the participant from the main study. An adult who compared well with the selection criteria, but who was not late-implanted, was identified. The participant in the pilot study complied with the selection criteria, except for the age of implantation, which was earlier than for the late-implanted prelingually deafened adults.

3.6.3. Material for the pilot study

A formal interview with the participant in the pilot study was conducted in order to assess the content, wording, and clarity, as well as the appropriateness of the questions. The interview was concluded with a discussion of the interview schedule in terms of suggestions and comments. The objective test battery is an established tool used at the Department of Communication Pathology, University of Pretoria and not included in the piloted study.

3.6.4 Procedures of the pilot study

The participant was contacted via telephone to request participation in the study. The aim of the pilot study was discussed and thereafter an appointment date was set. A letter of informed consent stating the purpose of the pilot and main study was given to the participant. After the signing of the letter of informed consent, the interview, according to the semi-structured interview schedule, was conducted. During the interview and the feedback session afterwards, weaknesses and ambiguities in the questions of the interview schedule were discussed and suggestions and comments were requested of the participant.

3.6.5 Results of the pilot study

The suggestions and comments made by the participant were used to adapt the interview schedule in order to ensure the appropriateness of the questions.

Changes mostly included the simplification of wording and language, as well as explaining certain questions. Three questions were edited in favour of simpler language and four questions needed to be explained with the use of examples. It was determined that approximately 30 to 35 minutes were required for the completion of the interview and the participant indicated that the time was not excessive. No unnecessary questions were indicated by the participant. The adapted interview schedule was used for the main study.

3.7 Data collection and data recording procedures

The different data collection procedures are discussed in detail in this section.

3.7.1 Overview of data collection procedure:

- Participants were selected from the PCIP client list and contacted in order to determine their willingness to participate in the study. A date that suited the participant was arranged for the data collection procedures. The participant was only required to meet the researcher once.
- On the arranged date, the participant met the researcher at the University of Pretoria at the Department of Communication Pathology. A written letter of consent was signed on this day in order to ensure that the researcher had informed consent from all the participants. They therefore provided written permission to participate in the research study.
- The semi-structured interview followed after informed consent was obtained. The duration of the interview was approximately 30 minutes.
- The participant was required to attend the interview and if necessary the significant other person was to accompany them.
- The testing of the participant’s auditory, language, and speech intelligibility abilities followed after a short break was provided. The test battery took approximately one and a half hour to complete.
- The results of the tests were recorded on the appropriate score sheets.
- Participants were thanked for their time and were contacted at a later stage to receive a summarized version of the results if requested.

3.7.2 Identification of participants

The participants were identified with the assistance of the coordinator of the PCIP according to the established criteria set out in Section 3.3.1. A letter to the Head of the PCIP was prepared in order to ask permission to approach the programme’s clients and to gain access to the clients’ records (See Appendix A). The selected participants were informed about the research project by means of sending an e-mail directly to them or telephoning a significant other who informed them about the nature, purpose, content, and implications of the study. It was determined if the client would be willing to participate in the project. Participation of young adults at the age of 16 years in the research project warrants the informed consent from the parents and assent from the young adult in order to ensure ethical conduct. The preferred language for completion of the questionnaire and the test battery was also determined.

3.7.3 Data collection procedures for the semi-structured interview

- Data was collected by means of a face-to-face semi-structured interview with each participant.
- The researcher read the closed-ended questions to each participant in the order of the schedule and the answers were subsequently recorded on the interview schedule (Maxwell & Satake, 2006).
- In addition, the researcher asked each participant a few open-ended questions in order to encourage the participant to express his / her thoughts, experiences and feelings that were related to the research question. The responses to the open-ended questions were immediately written down by the researcher on the interview schedule recording form. A tape recorder was used in conjunction to ensure that responses were written down accurately and truthfully.
- In three of the cases the researcher deemed it necessary to include a significant other person. Significant others were included, because these participants had limited language abilities. Therefore, during the interview, the significant other person played a role in translating, simplifying and verifying of information reported and provided by the participant. The presence of the significant others increased the amount of information obtained from the three participants, because they were able to comprehend the questions more accurately. The responses of the three participants, however, may have been influenced by the presence of the significant others and true feelings regarding the cochlear implant may have been inhibited.

3.7.4 Data collection procedure for the test battery: Auditory ability

3.7.4.1 Otoscopic examination

The audiological assessment started with an otoscopic examination. The purpose of the otoscopic examination was to examine the appearance and structure of the external auditory meatus and tympanic membrane (Katz, 2002). All normal and abnormal signs were documented on the audiogram in order to identify any necessity for a referral to the Ear, Nose and Throat specialist. An otoscopic examination is also part of the basic adult test battery used at the PCIP and was therefore conducted as part of standard procedure.

3.7.4.2 Tympanometry

Tympanometry enabled the researcher to determine the participant's middle ear functioning. Probes appropriately sized for each participant were inserted into their ears. The participant was provided with instructions regarding body posture during the testing, as well as on no swallowing, coughing or talking during the test. On the GSI-3 immittance meter, the "tymp" option was selected and the "←" button pressed. The immittance measurements were automatically documented on the computer and the researcher wrote it down on the audiogram (Soer, 2001).

The tympanogram was classified as either normal or abnormal. Based on the results of the tympanometry, the participants with abnormal results (tympanograms other than the Type A) would be referred to the Ear, Nose and Throat specialist and were excluded from the study until a Type A tympanogram was evident (Katz, 2002). No referrals were made to an Ear, Nose and Throat specialist.

3.7.4.3 Aided pure-tone thresholds

The participant's aided pure- tone thresholds were determined with the cochlear implant device switched to the regular setting. This enabled the researcher to obtain objective data regarding the auditory advantages and disadvantages associated with the use of a cochlear implant. Frequency specific thresholds were obtained at the following frequencies: 250, 500, 1000, 2000, 4000, 6000 and 8000Hz (Clark, 2003). These specific frequencies presented the researcher with threshold information about the participant's sensitivity for pure tones with the use of the cochlear implant (Hannley, 1986). A threshold is the level of sound that can only be detected 50% of the time (Tye-Murray, 2004). Free-field warble tones were used.

The participant was seated in the sound proof room. Instructions were provided in the soundproof room to enable the participant to use speech-reading optimally and to ensure that instructions were clear. The following instructions were provided: *Press the button every time you hear a "beep" sound, even when it is very soft.* Tones at all the above-mentioned frequencies were presented in a descending manner starting from 70dB or 80dB and going down in steps of 10dB, until the threshold for that frequency was determined. The determined threshold was presented a second time to ensure that the threshold intensity had been determined accurately. If the participant did not respond, steps of 5dB were used to increase the intensity until the tone was detected 50% of the time (Tye-Murray, 2004; Soer, 2001).

Ideally, cochlear implant users demonstrate aided thresholds of 25 to 40dB HL for the test frequencies 250 to 4000Hz (Katz, 2002) and determining these specific cochlear implant users' threshold allowed the researcher to determine what benefit is experienced. A cochlear implant does not always provide amplification at the 125 Hz frequency and this frequency was therefore excluded (Katz, 2002). The threshold at each frequency was recorded using a capital letter [C] for the free field thresholds with the use of a cochlear implant.

3.7.4.4 Aided speech audiometry measurements

Speech audiometry measurements are an important component of the audiological evaluation for various reasons. One of the most important reasons is that speech thresholds provide validating data for pure tone thresholds (Thibodeau, 2000). Speech measurements provide a means of assessing communication ability, namely the ability to understand speech (Kruger & Mazor, 1987). Due to the versatility of speech measurements both for diagnostic purposes and for understanding how hearing impairment affects communication ability, the measurements described below were applied.

All the aided speech audiometry measurements were conducted in three different methods of open-set speech, namely audition-only, audition-plus-vision, and vision-only.

- **Speech discrimination testing:**

The purpose of speech discrimination tests is to provide audiologists with information about how well the participant identifies words at a particular supra-threshold level and it evaluates the individual's ability to recognize words from a phonetically balanced word list (Katz, 2002; Martin & Clark, 2000). Speech discrimination varies from individual to individual, but results in the literature indicate that clients with normal hearing obtain 30% to 40% correct range on speech discrimination (Katz, 2002).

The following instructions were given to the participants regarding the speech discrimination testing: *You are going to hear some words preceded by the phrase "say the word" and you have to repeat the word as you hear it. The words will become softer and softer and more difficult to hear, but try to guess if necessary. I am going to cover my mouth, but please try not to look at my face while I am talking.* A list of 25 words was presented and the participant was expected to repeat the words. The starting intensity was 20dB above the pure tone average. One word at a time was presented by using the carrier phrase "say the word". At the end of each list, all the correctly identified words were counted and the results were expressed in percentage by multiplying the number of correct words by four. In the space reserved for speech discrimination results on the audiogram, a [C] was used to indicate the results.

- **Speech-in-noise testing:**

Speech embedded in the presence of competing noise was assessed as part of the speech measurements, due to the challenges involved in achieving good understanding of speech in the presence of background noise with the use of a cochlear implant (Clark, 2003; Katz, 2002). Maximum speech recognition at +2dB signal-to-noise ratio (S/N) can be achieved with 12 stimulus channels and at -2dB S/N ratio performance maximum occurs with 20 channels of stimulation (Clark, 2003).

The same instructions as for speech discrimination testing were used, except that the participant was instructed to ignore the noise. The S/N ratio was determined by means of presenting speech at 60dB HL and noise at 55dB HL through both speakers simultaneously. A list of 10 words was selected from the phonetically balanced word list and presented. The participant was requested to repeat the words that were heard at the end of the carrier phrase "say the word". The number of correctly identified words was multiplied by ten in order to determine the Speech-in-Noise score.

- **Central Institute for the Deaf (CID) Everyday sentence list**:

The *Central Institute for the Deaf (CID) Everyday sentence list* (Davis & Silverman, 1970; Muller & De Stadler, 1987) was used to assess the participants' speech recognition at a sentence level. The use of an open-set sentence test can provide an estimate of the participant's ability to communicate in the "real world" (Katz, 2002).

The following instructions on the execution of the CID everyday sentence test were provided: *I will read 10 sentences to you. After every sentence, you have to repeat the sentence. Repeat everything that you have heard. Please do not look at my face during the test.* Three lists of 10 sentences, containing a total of 50 key words, were utilised at three different intensities. The list was read at the same intensity used for the speech discrimination test. The participant was required to repeat each sentence as it was presented (Markides, 1987). All the correctly identified key words were counted and the total was then multiplied by two to obtain a percentage. Literature indicates that 65% or more sentence recognition in quiet surroundings can be obtained with the implant alone and 45% or more recognition in the presence of noise (+10dB S/N ratio) with the cochlear implant alone (Clark, 2003).

3.7.5 Data collection procedures for the test battery: Language abilities

The assessment tests discussed below were used in order to determine the participants' language abilities. Each test's manual was used to guide the researcher in the execution of the test. The tests enabled the researcher to objectively assess and determine the LIPD adults' communication-related language outcomes with the use of a cochlear implant.

- The Afrikaanse Reseptiewe Woordeskattoets (Buitendag, 1994) was used to assess each participant's receptive language abilities. The researcher explained the testing procedure to the participant and the following instructions were provided:
    - *We are going to look at a group of pictures.*
    - *There are four pictures on a page and each is numbered as 1, 2, 3, or 4. I am going to say a word and you have to select the picture that goes best with the word that I have said. You can either say the number of the picture or you can point to the selected picture.*

  Stimulus words were then presented and the participant was expected to indicate the picture that fitted the stimulus word (he / she had to choose the correct picture out of four response possibilities). The starting point for the test was at the 8-year old level, indicated at the left hand side of each column. A basal and ceiling score was determined. The basal score refers to the highest eight consecutive correct responses and the ceiling score is determined as the lowest eight consecutive responses containing six errors. The raw score was determined by subtracting the number of errors from the number of the ceiling item and according to the participant's raw score, his or her receptive language ability was determined.

- The Clinical Evaluation of Language Functions (Wiig & Semel, 1980), the Afrikaans translated version, was utilised to assess the participants' expressive language abilities and the specific section on testing expressive language abilities was used. The following subsections were conducted:
    - *Producing word series:* This subsection was used to assess the participants' accuracy, fluency and speed in recalling and producing

selected automatic-sequential word series. It contains two items. One item requires accurate and rapid recall and retrieval of the names of the days of the week and the second item requires recall and retrieval of the names of the months of the years. The responses to each of the items were scored for accuracy and speed (in seconds). The following instructions were provided: *I want you to tell me some names and I want you to do it as quickly as you can.* The responses to each were scored for accuracy and speed. The researcher checked whether the series was recalled accurately and in correct sequence. The speed of recitation of the word series was measured in seconds.

- *Producing names on confrontation:* This subtest was used to evaluate accuracy, fluency and speed in naming colours, forms and colour-form combinations. Visual stimuli were presented on three separate cards and the participant had to name the different stimuli on each card. The following instructions were provided: *Look at this card. It has several coloured circles/ shapes/ colours and shapes. I want you to tell me the colour/shape/colour and shape of each of the rest of the items.* The test items were designed to score accuracy and speed (in seconds). A stop-watch was used to determine the time required to name the visual stimuli. The researcher scored the accuracy on the score sheet by indicating only the error responses, placing a line through names which were omitted, a capital S above names which were substituted, a capital R above names which were repeated in succession and a capital A in spaces where names were added.
- *Producing word association:* This subtest evaluated the participants' ability to retrieve semantically related word series from long-term memory. The test assessed the production of two semantically related word series, namely foods and animals. The task required identification, retrieval, and production of as many class members as possible within a 60 second period for each of the semantic classes. The participant was instructed to think of some things that go together and tell the researcher the names of as many food/animals as he or she can. They were also instructed to do it as quickly as

possible. The responses were scored for quantity, namely the different members named for each semantic class. The quantity was determined by counting the total number of words produced and subtracting the number of repeated words.

- *Producing formulated sentences:* This subtest was used to assess the participants' ability to formulate and produce sentences when word and sentence form choices are limited. The test contained 12 items, each of which required formulation of a sentence which incorporated a specific stimulus word. The following instructions were provided: I am going to give a word to you and you have to make a sentence with the word. The responses to the sentence formulation items are scored for level of structural complexity in terms of grammaticality and level of complexity.

The researcher scored the participant's responses on the score sheet and analysed it according to the norms.

3.7.6 Data collection procedures for the test battery: Speech intelligibility and articulation abilities

LIPD adults often experience improvement in their speech production abilities (Waltzman, Cohen & Shapiro, 1992) and therefore it is important for this study to objectively assess each participant's speech intelligibility and articulation abilities. The assessment tests and checklist described below were utilised to determine the above-mentioned abilities. The tests' manuals were employed to ensure correct execution of the test.

- The Speech Intelligibility Rating (SIR) checklist, compiled by Dyar (2003), was completed by the researcher in order to evaluate each participant's speech intelligibility. The SIR checklist consists of six categories according to which the participant's speech intelligibility was rated and the categories extend from pre-recognizable words in spoken language (category 1) to intelligible speech to all listeners (category 6). The participant's speech intelligibility was evaluated by the researcher and then documented on the score sheet.

- The Afrikaanse Artikulasietoets (Lotter, 1974) determined the participant's articulation and speech abilities. In conducting the test, the participant was firstly provided with instructions on how the test would proceed and what would be expected of him / her. It included asking the participant to name the pictures that would be presented to them. Stimulus pictures that assess the individual's articulation of consonant sounds in words were presented with the directive "What is this?" The participant's responses were documented on the appropriate score sheet.

3.8 Data analysis

The information obtained from the interview and the data obtained from the test battery measurements were analysed individually. The test results were interpreted according to the test norms and were analysed according to these available norms. The analysed results from both data collection methods were then interpreted together in order to obtain the answer to the research question. Qualitative and quantitative methods were utilised to analyse and process data in cooperation with a statistician. The purpose of statistic methods is to summarize a set of raw data so that meaningful information can be extracted from it (Anderson, Sweeney & Williams, 2003). The presented sub-aims were used to guide the analysis and presentation of the information. Microsoft Office Excel (2007) was utilised for descriptive statistical analysis. It was used to calculate the mean (average) values from the evaluation scores. The analysed data enabled the researcher to identify common themes and trends and discuss these according to the sub-aims. The self-reported and objectively assessed communication-related outcomes of a cochlear implant for prelingually deafened adults could be deduced, once this process was completed. The individual results for each participant were not compared with results for other participants. Participants were measured according to their own abilities. The comparison of results between the various participants was not significant, due to the small sample that was used. The results and interpretations of the data are supported by and presented in tables, graphs, charts and figures.

3.9. Reliability, validity and trustworthiness

A multi-method research design, including both qualitative and quantitative research methods, was employed for the purpose of this study (Leedy & Ormrod, 2005). It is therefore important to include accountability measurements for both research methods.

Trustworthiness

Validity in the case of qualitative designs is the degree to which the interpretations and concepts have mutual meanings between the participants and the researcher (McMillan & Schumacher, 2001). According to Lincoln and Guba (1985) the key criterion or principle of good qualitative research is found in the notion of trustworthiness: the neutrality of its finding or decisions. Lincoln and Guba (1985) propose four constructs to reflect trustworthiness more accurately.

- *Credibility* is used as the alternative to internal validity. The goal is to demonstrate that the inquiry was conducted in such a manner as to ensure that the subject was accurately identified and described (De Vos et al., 2002). To help ensure credibility, selection criteria identified adults who had been a part of the PCIP since implantation. This enables to researcher to draw conclusions about this specific population.

- *Transferability* is the alternative to external validity. It refers to the extent to which the findings can be applied in other contexts or with other participants (Babbie & Mouton, 2001). During the research process, a theoretical framework was used to guide data collection and analysis. A wide and thorough literature base was used to justify and compose comprehensive and relevant questions for the semi-structured interview. The interview schedule was also compiled according to the study's objectives and questions that were vague, biased, and / or leading were eliminated (Leedy & Ormrod, 2005). To ensure further generalisability of the study, triangulation was implemented. Data from different sources was used to corroborate, elaborate and illustrate the research in question. The use of the semi-structured interview and use of objective testing methods strengthened the study's usefulness for other settings (De Vos et al., 2002). This study described only the late-implanted prelingually deafened adult population, and consequently transferability would be limited and no generalizations to a larger population could be made.

- *Dependability* can be seen as the alternative to reliability. A research study must provide evidence that if it were to be repeated with the same or similar respondents in the same context, its findings would be similar (Babbie & Mouton, 2001). The issue of dependability was addressed by using the same interview schedule, as well as the same objective test procedures with all the participants.

- *Confirmability* is the degree to which the findings are the product of the focus of the inquiry and not of the biases of the researcher (Babbie & Mouton, 2001). A semi-structured interview was used to represent the qualitative aspect of the study and it consisted of open-ended and close-ended questions. The confirmability of the research was improved by the use of a pilot study and subsequent revision of the interview schedule. Due to the limited language ability often present in the LIPD population, it was important that the pilot study determined if the questions for the interview was answerable, simple, and understandable, in order to ensure that the researcher could ask questions in an objective manner.

Validity

In the context of quantitative research design, the term validity refers to the degree to which scientific explanations of phenomena match the realities of the world. Internal validity expresses the extent to which extraneous variables have been controlled and accounted for. External validity refers to the generalisability of the results, the extent to which the results and conclusions can be generalised to other people and settings (McMillan & Schumacher, 2001). The use of an established, formal objective test battery for the quantitative side of research, addressed both internal and external validity. The objective test measurements have already been statistically and scientifically approved and are used at the Department of Communication Pathology, University of Pretoria as tools for determining auditory, speech and language abilities.

Reliability

Reliability refers to the consistency of measurement, the extent to which the scores are similar over different forms of the same instrument or occasions of data collection. With the goal of using reliable measurements in order to minimize the influence on the scores of chance or other variables, each test measurement was conducted according to established procedures described in each test's manual and instructions (McMillan & Schumacher, 2001). In doing this, internal consistency reliability was maintained. Internal consistency reliability is the extent to which all the items within a single instrument yield similar results (Leedy & Ormrod, 2005).

3.10 Conclusion

This chapter provides a comprehensive description of the procedures that were implemented in the research methodology to acquire the data according to the sub-aims, in order to address the main aim of the study. The purpose of the study was to determine the communication-related outcomes of LIPD adults in order to establish if it is worthwhile to implant this population. The research design was outlined, followed by the discussion of the participants, which included selection criteria, sample size and description of the sample. The ethical considerations regarding the study followed. The data collection instruments and apparatus used for the selection of data were subsequently discussed, followed by the pilot study results and the data collection and recording procedures. Data analysis procedures were also discussed and the chapter concludes with a description of the reliability, variability, and trustworthiness of the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

It is evident throughout the literature that the communication-related outcomes of late-implanted prelingually deafened (LIPD) adults are unexplored and this is the case within the South African context as well. This investigation therefore aimed to determine and describe the self-reported and objectively assessed communication-related outcomes of LIPD adults.

The results presented in this chapter are based on information and responses obtained from a LIPD adult cochlear implant users during a semi-structured interview, as well as from data obtained from an objective test battery.

In the first instance biographical information gathered from the individual participants is presented. The information includes particulars concerning the cochlear implant. This type of data is relevant as the results for the various types of cochlear implant outcomes for each participant were interpreted against the backdrop of his/her individual characteristics.

As pointed out in the first chapter, communication-related outcomes of cochlear implant use by LIPD adults can be described according to their audiological, language, and speech intelligibility functioning, as well as their quality of life experiences. The particular outcome categories were detailed in the aims set for the study, and determined the sequence in which the results will be presented. The first sub-aim was to establish the self-reported and objectively assessed auditory outcomes. Following the discussion of sub-aim one, results regarding the self-reported and objectively assessed communication-related language outcomes are presented (sub-aim 2). The third sub-aim was to determine the self-reported and objectively assessed communication-related speech intelligibility outcomes. The last sub-aim, namely the self-reported communication-related quality of life outcomes, will conclude this section.

The outcomes of the participants' cochlear implant use are presented and amplified by firstly considering the outcomes of all participants involved and then interpreting each participant's performance individually. In the final instance possible contributing factors that may be evident in the participant's background information are considered, and the results are discussed with reference to previous research.

4.2 Biographic, implant- and speech processor- related data of participants

Seven participants who are LIPD adult cochlear implant users were included in the study. All the LIPD adults from the PCIP were considered as potential participants for the study. In total, nine persons complied with the selection criteria and were contacted. Seven of these nine were willing to participate. If the population is relatively small, as is the case in this study, the sample should comprise a reasonably large percentage of the population (Strydom & Venter, 2002). In this study, 77% (7 out of a total of 9 patients) of the LIPD population associated with the PCIP participated at the time of data collection. This percentage can be regarded as representative of the LIPD population of this programme.

4.2.1. General Information

In Table 4.1 the relevant biographical and other personal information regarding the participants was compiled in order to provide a holistic view of the individual characteristics of the participants in the study. *Section A – General Information* of the interview schedule was used to obtain this information.

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Table 4.1: Summary of all biographical, implant- and speech processor-related data of the participants (n=7)

Characteristic	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7
1. Biographical Information:							
Age	21yrs	23yrs 0mo	26yrs 8mo	27yrs 3mo	29yrs 6mo	29yrs 11mo	36
Gender	Female	Female	Female	Female	Male	Female	Male
Preferred language	Afrikaans	Afrikaans	Afrikaans	Afrikaans	Afrikaans	Afrikaans	Afrikaans
Occupation							
- **Years**	3 +	3 +	3 +	3 +	3+	3 +	3 +
- **Work**	Scholar	Beauty technician	Computer technician	No occupation	Self-employed artist	Student in English studies	Laboratory
- **Occupation-related communication demands**	Moderate	Moderate	Moderate	N/A	Moderate	A great deal	Moderate
- **Prime locality of time spend after hours**	At home	At home	At home	At home	At home	At home	At home
- **After hours communication demands**	A great deal	A great deal	Very little	Moderate	Moderate	Moderate	A great deal
2. Hearing history:							
Cause of HL	Com-plications during birth	Meningitis	Meningitis	Renalragitis with multiple handicaps	German Measles	Congenital (unknown cause)	Congenital (unknown cause)
Approximate age of identification	2 y	2 y	3 y	2 y 3 mo	Birth	Birth	Birth
Age of initial HA fitting (both ears)	2 y	3 y	3 y	7 y	3 y	2 y	Birth
Extent of HA use per day prior to CI	6 -10 hours	1-2 hours	Never	More than 10 hours	3-5 hours	6-10 hours	More than 10 hours
Extent of current contralateral HA use per day	Never	Never	Never	Never	Never	Never	More than 10 hours
3. Speech & Language History:							
Communication mode before implantation	Mostly same amount of spoken and Sign language	Mostly same amount of spoken and Sign language	Mostly same amount of spoken and Sign language	Mostly Sign Language	Mostly same amount of spoken and Sign language	Mostly same amount of spoken and Sign language	Mostly same amount of spoken and Sign language
Communication mode after cochlear implantation	Mostly same amount of spoken and Sign language	Mostly same amount of spoken and Sign language	Mostly spoken language	Mostly Sign Language	Mostly spoken language	Mostly same amount of spoken and Sign language	Mostly same amount of spoken and Sign language
Type of primary school	Special school: State	Special school: State	Special school: State	Special school: State	Special school: State	Special school: State	Special school: State

Type of secondary school	Special school: State	Special school: State	Special school: State	Special school: Private	Special school: State	Special school: State	Special school: State
4. CI information:							
Number of CI	One	One	One	One	One	One	One
Age when CI was received	12 y	22 y	24 y	20 y	28 y	27 y	35 y
Type of CI	Nucleus 24 Contour	Freedom with Contour Advance	Nucleus 24 Double Array	Nucleus 24 Contour	Freedom with Contour Advance	Nucleus 24 with Contour Advance	Freedom with Contour Advance
Type of speech processor	Esprit 3G	Freedom	Esprit 3G	Esprit 3G	Freedom	Esprit 3G	Freedom
Type of speech coding strategy	Slow-rate ACE	Slow-rate ACE	Slow-rate ACE	SPEAK	Slow-rate ACE	SPEAK	Slow-rate ACE
Extent of CI use per day	More than 10 hours	More than 10 hours	More than 10 hours	More than 10 hours	More than 10 hours	More than 10 hours	More than 10 hours
Use of HA in contralateral ear	No	No	No	No	No	No	Yes
Auditory rehabilitation:							
- **Received**	Yes	Yes	Yes	Yes	Yes	Yes	Yes
- **How often**	Weekly	Weekly	Weekly	Weekly	Weekly	Weekly	Monthly
- **Period**	More than 6 months	More than 6 months	More than 6 months	More than 6 months	More than 6 months	More than 6 months	More than 6 months
- **Currently received**	No	No	No	No	No	No	No

As seen in the first section of Table 4.1, all participants were Afrikaans speaking adults between the ages of 21 and 36, with the average age at 27.6 years. Five females and two males participated in this study. Forty-five percent of all the adult implantees of the PCIP are male and 55% are female. The data is representative of the current adult cochlear implant users of the PCIP (Updated list of adult cochlear implant users of the PCIP from 1991 to 2008). The male/female ratio of cochlear implant users represented in this study is 29% to 71%, which indicates that more prelingually deafened adult females are implanted. Four of the participants are in a steady occupation, whereas participant one and six are respectively a scholar and a student. Participant 4 is multi-handicapped and has not been able to work permanently. All the participants, except for the one who does not work (Participant 4), have been in their respective occupations for more than 3 years. The four participants that are currently in a permanent occupation (Participants 2, 3, 5 and 7) as well as the scholar (Participant 1), indicated that they need a moderate degree of communication for work. The student (Participant 6) indicated that an extensive amount of communication is necessary at the university where she studies. Their living circumstances, as well as their communication needs after hours were determined. All the participants indicated that they spent most of their time after hours at home. Three participants (Participants 4, 5 and 6) needed a moderate amount of communication at home, whereas another three (Participants 1, 2 and 7) indicated that a great amount of communication is needed after hours. Only one participant indicated that very little communication is needed. The information obtained indicated that communication is an important part of these participants' lives, and this makes the measurement of communication-related outcomes worthwhile.

4.2.2 Hearing history

Section A – Information regarding hearing history was used to determine all relevant information regarding the participants' hearing loss. Information regarding the cause and age of identification of the hearing loss, as well as information regarding hearing aid use prior to the cochlear implant, was obtained for each participant and is presented in Section 2 of Table 4.1

It is important to highlight certain individual characteristics of each participant in order to determine their predictive factors related to their hearing history.

- **Participant 1**

Participant 1's hearing loss was identified at the age of two and she was immediately fitted with hearing aids, which she used consistently for most of the day before receiving the cochlear implant at the age of 12 years. The early age of deafness can be regarded as a possible predictive factor. The aetiology of deafness was complication during birth.

- **Participant 2**

Participant 2 acquired her hearing loss due to meningitis at the age of the two, but she was only fitted with hearing aids at the age of three, which implies that she had three years of limited auditory stimulation during the early speech and language development years. She received her cochlear implant at the age of 22 years. Aetiology of deafness, age when deafened and duration of deafness can be considered as predictive factors.

- **Participant 3**

Meningitis was the aetiology of deafness for Participant 3 and this disease occurred at the age of three. She was fitted with hearing aids immediately, but she indicated that she never used the aids. She was implanted with the cochlear implant at the age of 24 years.

- **Participant 4**

Participant 4 has Renal ragitis with multiple handicaps, and presents with both hearing loss and blindness. She was diagnosed with De Toni Fanconi Syndrome.

She acquired her deafness at the age of two years and three months, but was only fitted with hearing aids at the age of seven. She did, however, use the hearing aids constantly. The presence of her multiple handicaps may contribute to poorer predictive factors. She received her cochlear implant at the age of 20.

- **Participant 5**

Participant 5's mother had German measles during pregnancy and he was congenitally profoundly hearing impaired. He did not have any exposure to auditory stimuli during the early speech and language development years and only received hearing aids at the age of three. His early onset of deafness, lack of auditory stimulation and limited use of the hearing aid can contribute to poorer expected outcomes. He received his cochlear implant at 28 years of age.

- **Participant 6**

Participant 6 is congenitally deaf, but was only fitted with hearing aids at the age of two. She used her hearing aids daily for most of the day. She was still excluded from sound, however, in the essential early developmental years and this factor can contribute to poorer expected outcomes. She was implanted at the age of 27.

- **Participant 7**

In terms of hearing history, Participant 7 made optimal use of auditory stimulation since birth and continues doing so currently. He is congenitally deafened, but started using his hearing aid just after birth and is also currently using a hearing aid in combination with his cochlear implant. He received his cochlear implant at the age of 35.

A more detailed discussion of the participants as a group will be presented in the ensuing paragraphs.

A person who has a prelingual hearing loss incurred the loss before the acquisition of spoken language skills. According to the literature there is no universally agreed cut-off time as to when the prelingual phase ends, but is usually described as before two to three years of age (Tye-Murray, 2004). All the participants incurred their hearing loss between birth and three years of age, which indicates prelingual deafness in all the participants. The causes of hearing loss include renal ragitis, meningitis, complications during birth, and congenital hearing loss of an unknown cause. Three of the participants (Participants 1, 3 and 7) were fitted with hearing aids directly after the hearing loss was identified, whereas the rest of the participants were only fitted between one and five years after the hearing loss was identified. Speech and language skills are typically developed during the first three years of a child's life, and obtaining the hearing aid at a later stage will influence this aspect of development negatively (Clark, 2003). The extent of hearing aid use prior to the cochlear implant differed from participant to participant. Two participants (Participants 4 and 7) used the hearing aid for more than 10 hours a day, two (Participants 1 and 6) used it between 6 and 10 hours, one (Participant 5) used it between 3 and 5 hours and Participant 2 used it between 1 and 2 hours a day. Participant 3 indicated that she never used the hearing aid prior to the cochlear implant. Six of the participants do not use a hearing aid contralaterally since the cochlear implant was received, while only one participant (Participant 7) is still utilizing the hearing aid in the opposite ear. The use of a hearing aid contralaterally to a cochlear implant can contribute to better sound localization and improved hearing of speech in noise (Clark, 2003).

4.2.3 Speech and language history

The participants' speech and language history was broadly taken into account by inquiring about the communication mode before and after cochlear implantation, as well as the type of schooling during primary and secondary school phases. The mode of communication was investigated in order to obtain information regarding the specific relationship between Sign Language and spoken language. *Section A – Information concerning speech and language history* was used to obtain the information, and data collected is summarized in Section 3 of Table 4.1.

Six out of the seven participants (all except Participant 4) made use of approximately the same amount of spoken and Sign Language prior to the cochlear implant. The participant who is multi-handicapped (Participant 4) mainly used Sign Language as mode of communication before and after receiving the cochlear implant. Two of the participants (Participants 3 and 5) indicated that since receiving the cochlear implant, they now mainly use spoken language to communicate, whereas four participants (Participants 1, 2, 6 and 7) still mostly use the same amount of spoken and Sign Language. All the participants attended a state funded primary special school in Pretoria, namely Trans-Oranje School for the Deaf. Six of the participants continued their education within this school setting where Total Communication is encouraged. The participant with multiple handicaps (Participant 4) attended a private special school where children with multiple handicaps and Sign Language as mode of communication are allowed. Taking into consideration the LIPD adults' mode of communication and schooling prior to implantation, it can be concluded that not all the participants had optimal factors contributing to better post-implantation outcomes.

Figure 4.1 provides a summary of the communication mode used by all participants before and after cochlear implantation.

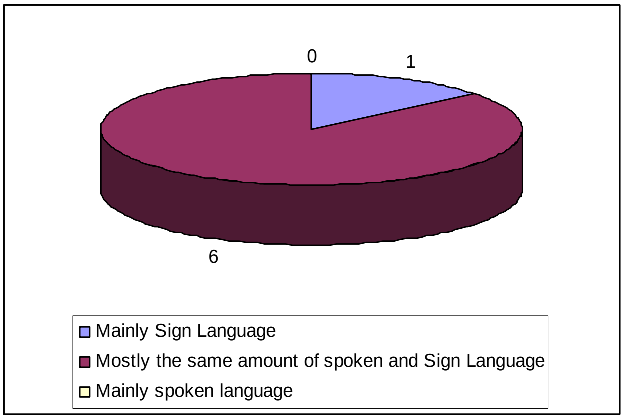
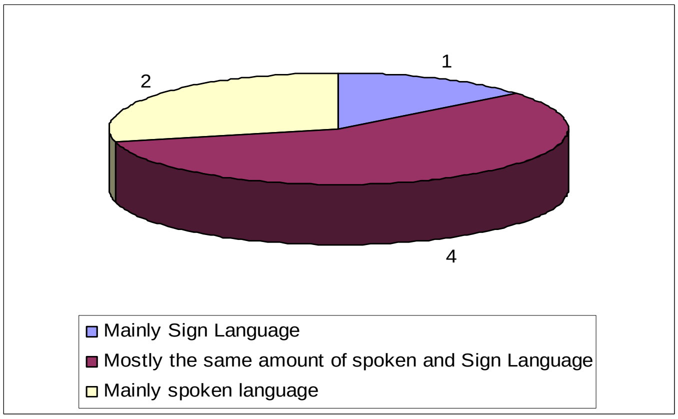
COMMUNICATION MODE BEFORE COCHLEAR IMPLANT	COMMUNICATION MODE AFTER COCHLEAR IMPLANT
	

Figure 4.1: Communication modes before and after cochlear implantation (n=7)

4.2.4 Information regarding cochlear implant

Section A – Information regarding the Cochlear Implant was used to obtain data regarding the participants' cochlear implants and the utilisation of the device. Important variables regarding age of implantation, type of implant, speech processing and coding strategies were determined, and information was gathered regarding auditory rehabilitation. This information can be used to make important inferences and to highlight possible trends in this specific population. Data collected for each participant in this regard is summarized in Table 4.1 (See section 4.2.1).

All the participants received the cochlear implant after at least ten years of hearing aid use alone, which constitutes to a certain amount of auditory deprivation. Auditory deprivation occurs when the duration of sound deprivation increases and it depends on the age at onset of deafness, the duration of deafness, and the age of implantation (Clark, 2003; Sharma, Dorman & Spahr, 2002). During the critical phase of auditory maturation plasticity, sound exposure or electrical stimulation is required for the neural connection to achieve place coding of frequency, and this is important for optimal speech perception (Clark, 2003). With prelingually deafened adults it appears that the deafness induces changes along the entire auditory pathway. This effect includes the degeneration of the auditory nerve, the alteration of synaptic structures in the midbrain, and the failure to establish appropriate intra-cortical projections in the auditory cortex, all contributing to the gradual deterioration of auditory performance with increased duration of auditory deprivation (Wooi Teoh, Pisoni & Miyamoto, 2004). Auditory deprivation may also cause cross-modal recruitment. Cross-modality often occurs in the affected or deprived auditory cortex by recruiting the visual or somatosensory modalities. It causes the auditory cortex to rewire and to develop other skills, for example during the development of Sign Language. Cross-modality often occurs as an adaptive mechanism when duration of sound deprivation increases and is often irreversible after seven years of age (Sharma, Dorman & Spahr, 2002; Sharma, Dorman & Kral, 2005). Auditory deprivation and cross-modality are the effects of long duration of deafness. It is therefore important to take into account the influence of hearing aids, as well as the cochlear implant history of each individual participant when interpreting outcomes data.

All the participants were only implanted with one cochlear implant. The two main reasons for choosing unilateral implantation are financial or medical reasons. Candidates who became deaf due to meningitis present with cochleas that are calcified. They are usually implanted in the ear that is less calcified and can therefore only obtain one cochlear implant. A second cochlear implant is also expensive and the dollar/rand exchange rate often does not allow persons to obtain a second cochlear implant when their medical aid does not fund it (Chester-Browne, R., Pers.Comm, 2008). The cochlear implant is used daily for more than 10 hours a day by all the participants.

- **Type of cochlear implant device**

The participants use a variety of types of cochlear implants as is illustrated in Figure 4.2.

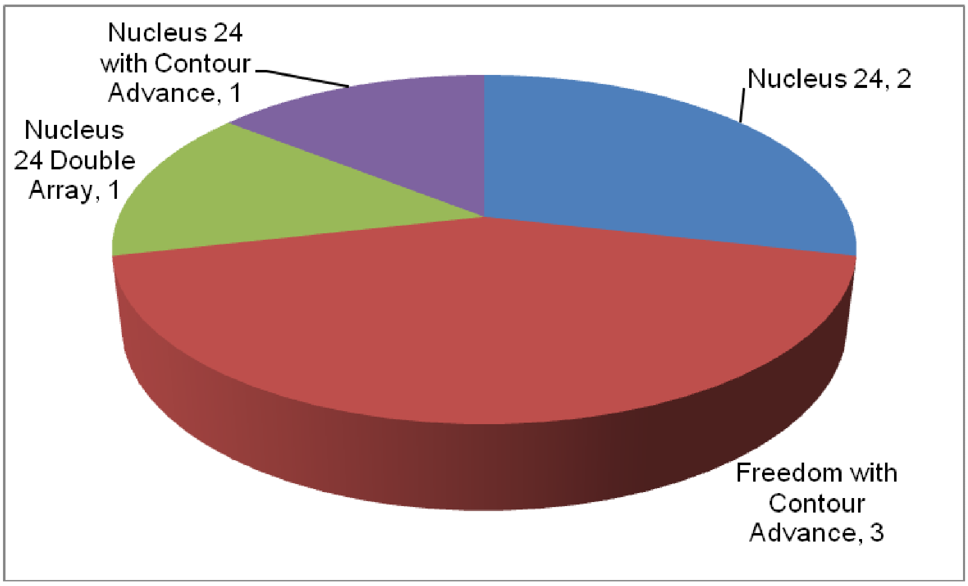


Figure 4.2: Type of cochlear implant systems used by participants (n=7)

When discussing the cochlear implant models, processing, and coding strategies, and with consideration of all the products available at the PCIP, it is important to note that each individual received a cochlear implant according to what had optimal benefits for his/her specific needs. All the participants who were implanted at least one year prior to the study, received the latest type of cochlear implant distributed by Cochlear Corporation, namely the Freedom with Contour Advance. As indicated in Table 4.1 (Section 4), Participant 3 and 6 respectively use the

Nucleus 24 Double Array (due to calcification in the cochlea) and Nucleus 24 with Contour Advance. The participants who were implanted first (Participants 1 and 4) make use of an older type of cochlear implant, namely the Nucleus 24. The Contour type device (used by Participants 2, 5, 6 and 7) refers to the self-curling electrode insertion method. This curved cochlear electrode array is artificially straightened when inserted and then allowed to curl once placed into the cochlea. This curled electrode is advantageous as its position is nearer to the modiolus and therefore nearer to the auditory nerve. It provides more precise stimulation of the nerve and may lead to better hearing perception (Moore & Teagle, 2002).

- **Speech processors and coding strategies**

In Figure 4.3 the type of speech processors used by participants is presented.

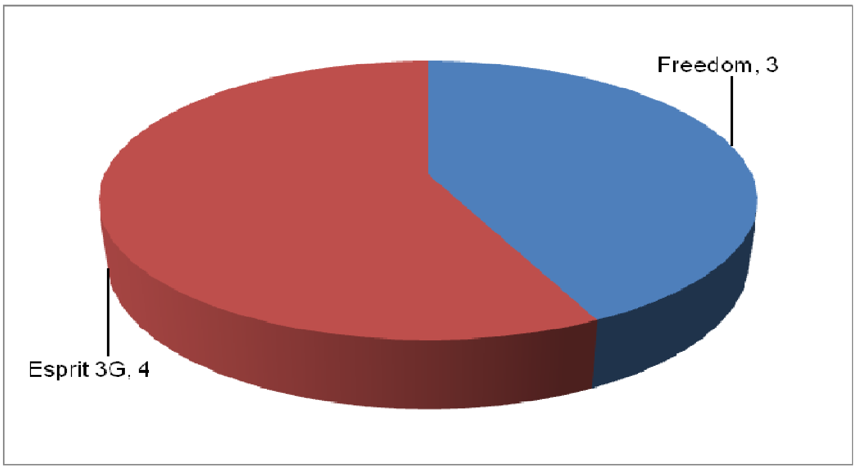


Figure 4.3: Type of speech processors used (n=7)

All of the participants wore ear level processors. Four of the participants use the Esprit 3G speech processor. The remaining three participants, who use the Freedom implant system, also make use of the ear level Freedom speech processor. Two of the participants made use of the SPEAK speech coding strategy, whereas the others made use of the ACE strategy with a slower processing rate of 500Hz. The SPEAK (Spectral Peak) strategy is a speech coding strategy using a dynamic filter to analyze the information in the acoustic signal. Stimulation with this speech coding strategy occurs at low constant rates and provides stimulation at up to 22 stimulation sites. These lower rates have been proven to be more advantageous for persons with meningitis (Clark, 2003) and were therefore considered appropriate for Participant 2 and Participant 3. The ACE (Advanced Combination Encoder) strategy is a modification of SPEAK, with stimuli presented at high rates and/or with more channels. According to Clark (2003), it combines the best attributes of both CIS and SPEAK processing strategies. By lowering the ACE rate to 500H, the person receives a similar speech coding strategy to SPEAK. The type of speech coding strategies used by the seven participants is presented in Figure 4.4 below and specified in Table 4.1, Section 4.

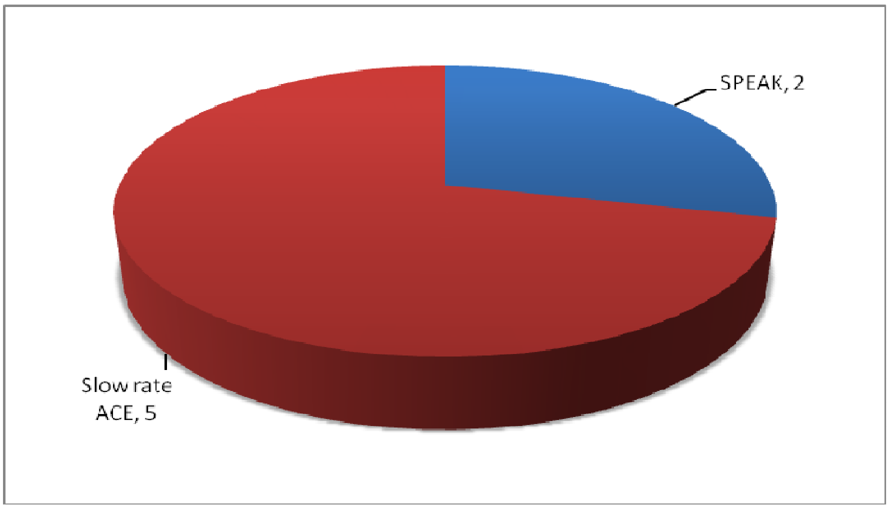


Figure 4.4: Type of speech coding strategies used (n=7)

- **Auditory rehabilitation following cochlear implant**

The aim of auditory rehabilitation is to produce the maximum benefit for the cochlear implant user (Clark, 2003) and the rehabilitation process can be regarded as a predictive factor for post-implantation outcomes. Table 4.1, Section 4 provides a summary of participants' auditory rehabilitation following the cochlear implant.

All the participants indicated that they received auditory rehabilitation after receiving the cochlear implant on either a weekly or monthly basis. They all received these services for more than six months after the implantation. As mentioned in Chapter 2, auditory rehabilitation is part of the cochlear implant process and provided by the cochlear implant team, especially the audiologist and speech-language therapist.

4.3 Audiological outcomes- Description and discussion of results for sub-aim 1.

Prelingually deafened adults using a cochlear implant often obtain less benefit in speech recognition and are often unable to recognize any open-set words or sentences (Zwolan, Kileny & Telian, 1996). They do, however, indicate that they experience an increased awareness of environmental sound and other self-reported audiological advantages (Zwolan, Kileny & Telian, 1996). Both the objectively assessed and self-reported audiological outcomes for LIPD adults must therefore be taken into consideration when the audiological abilities of this population are determined.

4.3.1 Objectively assessed audiological outcomes

The objectively assessed audiological results will be discussed under the sub-headings: Aided sound-field thresholds, audition-only, open-set speech test, audition – plus – vision open-set speech tests and vision-only open-set speech test. Results in this regard are summarized in Table 4.2.

Table 4.2 Summary of all the objectively assessed audiological data of the participants (n=7)

Audiological results	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7
1. Otoscopic examination							
Right ear **Left ear**	Normal Normal	Normal Normal	Normal Normal	Not performed	Normal Normal	Normal Normal	Normal Normal
2. Tympanometry							
Right ear **Left ear**	Normal Normal	Normal Normal	Normal Normal	Not performed	Normal Normal	Normal Normal	Normal Normal
3. Aided sound-field thresholds:							
Aided pure tone audiometry (dB): **Average pure tone threshold**	33.3 dB HL	28.3 dB HL	35 dB HL	Not performed	25 dB HL	25 dB HL	25 dB HL
4. Audition-Only, Open-set Speech Test							

Speech discrimination of words (quiet): **Intensity 1** **Intensity 2** **Intensity 3**	28%@50dB 28%@ 60dB 44%@ 70dB	0%@ 50dB 4%@ 60dB 8%@ 70dB	0%@ 65dB 12%@75dB 8%@ 85 dB	Not performed	4%@ 50dB 12%@60dB 16%@70dB	0%@ 50dB 0%@ 60dB 0%@ 70dB	20%@50dB 28%@60dB 20%@70dB
Speech discrimination of words (noise):	30%	0%	0%	Not performed	0%	0%	10%
Speech discrimination of sentences: **Intensity 1** **Intensity 2** **Intensity 3**	20%@ 50dB 26%@ 60dB 22%@ 70dB	6%@ 70dB 10%@ 80dB 4%@ 85dB	0%@ 65dB 0%@ 75dB 2%@ 85dB	Not performed	0%@ 60dB 0%@ 70dB 2%@ 80dB	0%@ 60dB 0%@ 70dB 0%@ 80dB	12%@50dB 6%@ 60dB 10%@70dB
5. Audition-plus-Vision, Open-set Speech Test:							
Speech discrimination of words (quiet): **Intensity 1** **Intensity 2** **Intensity 3**	48%@ 50dB 52%@ 60dB 36%@ 70dB	24%@ 50dB 24%@ 60dB 28%@ 70dB	48%@60dB 40%@70dB 64%@80dB	Not performed	30%@50dB 36%@60dB 36%@70dB	24%@50dB 24%@60dB 32%@70dB	84%@50dB 72%@60dB 60%@70dB
Speech discrimination of words (noise):	20%	20%	50%	Not performed	30%	40%	50%
Speech discrimination of sentences: **Intensity 1** **Intensity 2** **Intensity 3**	50%@ 50dB 54%@ 60dB 4%@ 70dB	30%@ 50dB 40%@ 60dB 36%@ 70dB	78%@65dB 98%@75dB 74%@80dB	Not performed	36%@60dB 40%@70dB 38%@80dB	16%@60dB 24%@70dB 8%@80dB	62%@50dB 64%@60dB 54%@70dB
6. Vision-Only, Open-set Speech Test							
Speech discrimination of words	28%	40%	48%	Not performed	30%	32%	16%
Speech discrimination of sentences:	42%	40%	90%	Not performed	40%	24%	54%

Prior to these audiometric tests, otoscopic examinations and tympanometry evaluations were conducted. All the participants presented with normal bilateral external auditory meatuses. The tympanic membranes in both ears of all the participants were normal in appearance and structure. No abnormal signs were documented and therefore no referrals to an Ear Nose and Throat specialist were required. Type A tympanograms, indicating normal middle ear functioning, were elicited in all the participants and therefore no referrals to an Ear Nose and Throat specialist were required. Data collected for each participant in this regard is summarized in Table 4.2, Section 1 and 2.

4.3.1.1 Aided Sound-Field Thresholds

The participants' aided sound-field thresholds were evaluated by means of conducting pure-tone air audiometry. The results as summarized in Table 4.2, Section 3 will be discussed below.

It is important to note that Participant 4 did not participate in the pure tone and speech audiometry measurements and CID Everyday sentence discrimination measurement, due to her multiple disabilities and inability to follow instructions and use visual aids. The tympanometry and otoscopic examination were not conducted due to her unwillingness to undergo the procedures. She was, however, not excluded from the study, because prelingually deafened adults with multiple handicaps, especially visual impairment, are candidates for a cochlear implant. The self-reported data that she has provided can be regarded as valuable information regarding cochlear implant use when similar cases or candidates are considered. Table 4.3 describes the aided pure tone audiometry thresholds obtained for each participant.

Table 4.3: Aided pure tone thresholds (n=6)

Participant no.	250Hz	500Hz	1000Hz	2000Hz	3000Hz	4000Hz	6000Hz	8000Hz	*Average Pure tone Thresholds
1	30dB	40dB	35dB	25dB	35dB	30dB	25dB	25dB	33.3dB
2	30dB	25dB	25dB	35dB	30dB	35dB	25dB	25dB	28.3dB
3	30dB	35dB	35dB	35dB	35dB	35dB	30dB	30dB	35dB
5	25dB	30dB	25dB	20dB	25dB	35dB	30dB	50dB	25dB
6	25dB	25dB	25dB	25dB	25dB	25dB	25dB	25dB	25dB
7	20dB	25dB	30dB	20dB	30dB	35dB	30dB	70dB	25dB
Mean average:	26.6dB	30dB	29.2dB	26.6dB	30dB	32.5dB	27.5dB	37.5dB	28.6dB

*** Pure tone average is determined by the following formula: [(Threshold at 500Hz + threshold at 1000Hz + threshold at 2000Hz) divided by 3] (Katz, 2002: 98)**

When considering the aided pure tone results in Table 4.3, certain individual results must be highlighted. Participant 1's thresholds at the higher frequencies are better in relation to the lower frequencies; and in contrast with this Participant 5's thresholds in the higher frequencies are poorer than in the lower frequencies. Participant 2 experiences more problems with the hearing of pure tone sounds in the middle frequencies than in the lower and higher frequencies, whereas Participant 3 consistently obtained thresholds of 30dB or more and also has the highest pure tone average of all the participants. Participant 6 obtained good pure tone thresholds throughout the frequency range, and thresholds of 25dB were observed from 250Hz to 8000Hz. Participant 7 also experienced problems with the highest frequencies and the threshold at 8000Hz was poorer than the other thresholds.

The audiograms indicated that the average pure tone thresholds (PTAs) for all the participants were between 25 and 35dB. Participants 4, 5, and 7 maintained average thresholds of 25dB, Participant 2 an average of 28.3dB and Participants 1 and 3 at 33.3dB and 35dB respectively. The thresholds with the cochlear implant for all the participants were substantially closer to normal hearing, which indicates that all the participants experienced benefit in terms of non-speech sounds. The results obtained correlate with a study conducted by Skinner, Binzer, Fears, Holden, Jenison and Nettles (1992). In this study, the authors found that the LIPD participants were able to hear the full range of sounds from low to high pitches across the frequency range 250 to 4000Hz. The results of Participants 4 and 5 indicated that their ability to hear sounds at 8000Hz decreased to 50dB and 70dB respectively. The study by Skinner et al. (1992) already indicated that cochlear implant users can obtain near-normal thresholds across the frequency range 250 to 4000Hz. Therefore, it can be expected that thresholds for frequencies above 4000Hz will not always be as good as the other speech spectrum frequencies.

These results may be seen as an indication that the implantation of LIPD adults can be considered appropriate on the grounds of their pure tone audiometry results alone. Since these participants' pre-implantation residual hearing thresholds showed severe-to-profound hearing losses, the improvement in the non-speech sound detection since the cochlear implant was received, is significant (Skinner et al., 1992). The LIPD adults should be able to hear everyday environmental sounds considerably better and be able to perceive warning signals, like police sirens, house and car alarms as well as car horns. The ability to identify environmental sounds is important (Clark, 2003), and will enable the participants to function more independently and optimally in their work environments. The LIPD adults' improved aided pure tone thresholds might also improve their ability to recognize a phone ringing or the doorbell indicating somebody is at the door, which is important for independent functioning at home. Although environmental sounds are not pure tone sounds, they can be regarded as less complex sound stimuli, and are therefore somewhat similar to pure tone sounds.

It remains a necessity, however, that a cochlear implant user has the ability to perceive more complex and linguistically loaded signals and be able to process and recognize these signals.

4.3.1.2 Audition-Only, Open-set Speech Tests

The PCIP does not use speech production and speech intelligibility as measures of candidacy for prelingually deafened adults, therefore outcomes for this population may seem poorer than those obtained in other cochlear implant programmes.

Speech is the most complex, specialized, and important auditory signal (Clark, 2003). The observation that this population is dependent on speech-reading cues may give rise to some questions. The LIPD adults make use of speech-reading cues together with auditory information when communicating, rather than depending on auditory stimuli alone. The implication is that they may not be able to understand all people if they rely only on speech-reading cues. The presence of a moustache, poor lighting, and people who speak fast will impede full understanding, especially in group conversations (Tye-Murray, 2004). In these cases, it may be expected of the LIPD adults to make use of audition alone, which will not be sufficient for successful communication exchange.

The results of the speech discrimination testing of words in quiet and noise, as well as speech discrimination of sentences in an audition-alone, open-set speech environment will be discussed. The data collected and summarized in Table 4.2, Section 5 will be discussed.

- **Speech discrimination results: Wordlists in quiet environment**

The results of the speech discrimination testing are presented in Figure 4.5 and Figure 4.6.

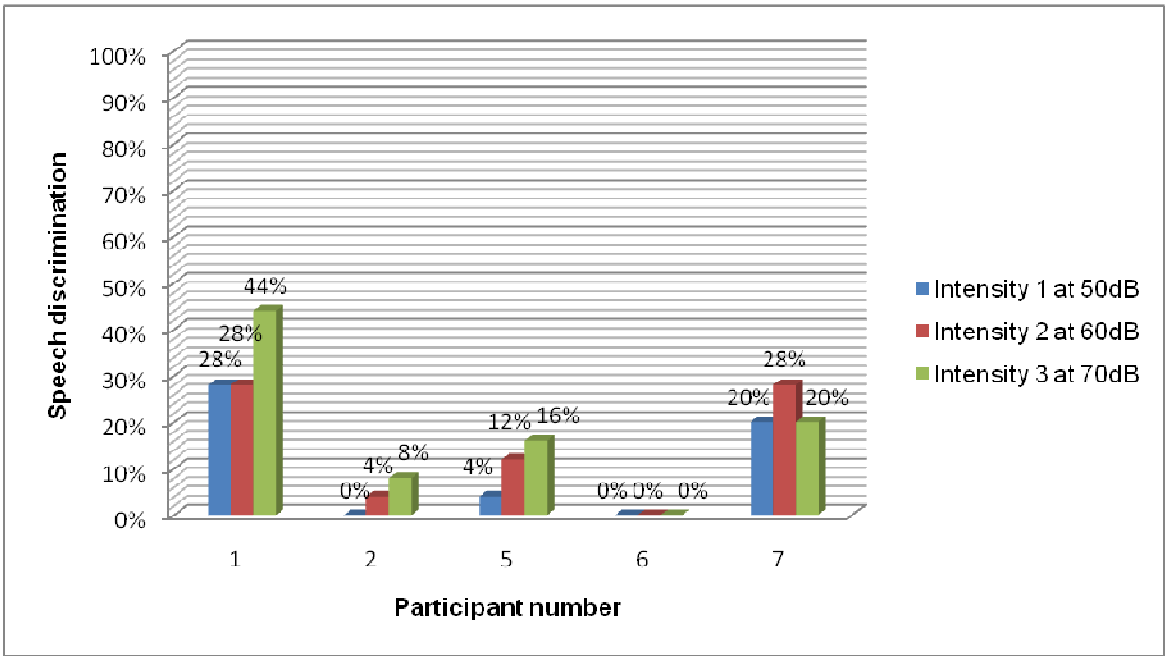


Figure 4.5: Speech discrimination results for wordlist in quiet environment: Participants 1, 2, 5, 6 & 7 (n=5)

The speech discrimination results for Participant 3 are presented in Figure 4.6. Participant 3's pure tone average was 35dB and therefore speech discrimination testing was started at 30dB above that level in order to ensure that a comfortable presentation level is obtained.

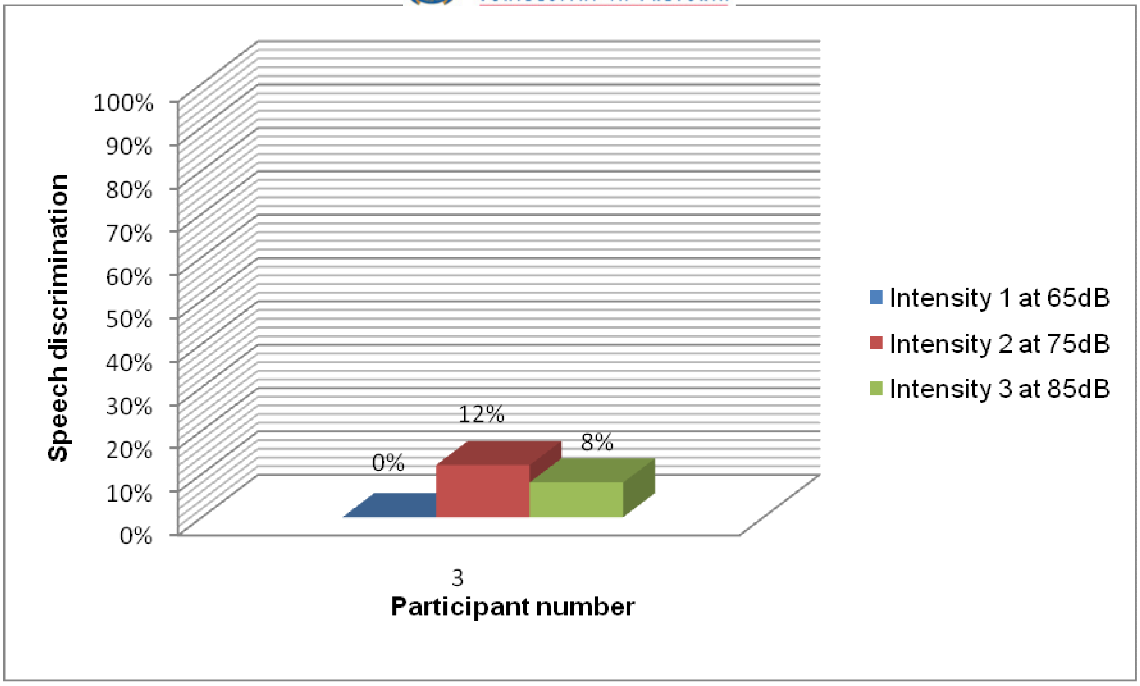


Figure 4.6: Speech discrimination results for wordlists in quiet environment: Participant 3 (n=1)

The audition-only speech discrimination testing was conducted at three different intensities as recommended by Bess and Humes (1990). Word recognition testing is a supra- threshold test and is typically performed at a presentation level that is comfortable to the client in order to determine the client's maximum score for phonetically-balanced words (PB-Max) (Katz, 2002). According to Bess and Humes (1990), the initial level of presentation for the words usually is 20dB or 30dB SL. Two other lists of words, 10dB above this value and also 10dB lower than the initial level, are presented.

Various studies (Shea, Domico & Orchik, 1990; Zwolan, Kileny & Telian, 1996; Wooi Teoh et al., 2004; Moody-Antonio, Takayanagi, Masuda, Auer, Fisher & Bernstein, 2005) concluded that the benefit most prelingually deafened adult cochlear implant users receive in terms of speech discrimination is limited, and that some individuals experience no benefit at all from a cochlear implant in this regard (Moody-Antonio, et al., 2005). From the results depicted in Figure 4.5 and Figure 4.6 it is evident that the participants in this study also obtained limited or no benefit from their cochlear implant, if auditory-alone speech discrimination of words is considered. Participant 2, who had a 28.3dB pure tone average, obtained a maximum of 8% open-set word discrimination at 70dB. Participant 3, who had a pure tone average of 35dB, obtained a maximum of 12% open-set word discrimination and Participant 5 obtained 16%, with a pure tone average of 25dB. Participant 7, who had a 25dB pure tone average, obtained a maximum of 28% open-set word discrimination. Participant 6 not obtain any percentage of speech discrimination at any of the three intensities. Participant 1 presented with the highest word discrimination score and obtained a maximum of 44% open-set word discrimination at 70dB. The average speech discrimination ability of the participants is therefore 18%, which can be considered as poor speech discrimination. This correlates with other research studies where it was found that LIPD adults cannot recognize words using the cochlear implant alone without speech-reading cues (Skinner et al., 1992).

- **Speech discrimination results: Wordlists in noisy environment**

Table 4.2, Section 4 lists the speech discrimination results of words in noise (Speech-in-Noise Test) obtained in an open-set setting at a speech-to-noise ratio of 60:55 dB.

A speech discrimination level of 60dB was used because it represents a comfortable hearing level (Katz, 2002). Speech perception is evaluated in the presence of noise at a Signal-to-Noise ratio of +5dB (Clark, 2003) and therefore the speech to noise ratio of 60:55 dB was used. According to Katz (2002), background noise can compromise speech perception by masking the acoustic and linguistic cues in the message. It is therefore important to determine the participants' ability to perceive speech in the presence of noise because it provides a better reflection of how a person functions in everyday noisy environments. In Table 4.2, four of the participants (Participant 2, 3, 5 and 6) obtained 0% speech-in-noise discrimination. Participant 7 obtained 10% speech discrimination and Participant 1 obtained 30% speech-in-noise discrimination. The results demonstrate that most of the participants have severe difficulties with the discrimination of speech in the presence of background noise.

Certain individual characteristics could be observed from the audiometric results. Participant 1 obtained the highest speech discrimination of words in both quiet and noise environments and if cochlear implant related data is considered as well, she was implanted at the earliest age (12 years). In this participant's case, the duration of deafness was shorter (10 years) and the age of implantation (12 years) earlier. Both these predictive factors have a positive influence on her speech discrimination skills (Wooi Teoh et al., 2004). In contrast, Participant 6 obtained the lowest speech discrimination results both in quiet and in noise, namely 0% in both cases. This participant was only implanted at the age of 27 years, but was hearing impaired since birth, so that the duration of deafness and age of implantation are negative prognostic factors. Participant 2 obtained minimal benefit in terms of speech discrimination in quiet and noise. This participant was not able to discriminate words in noise (0% speech discrimination was obtained), and speech discrimination in quiet was not much different (8% at 70dB was obtained in the quiet). Duration of deafness and age of implantation are both factors that influence the outcomes in terms of auditory-alone speech discrimination in this participant's case. Participants 3 and 5 obtained similar auditory-alone open-set speech discrimination results to Participant 2, and the same predictive factors can be considered. Participant 7 was implanted at the latest age viz. 35 years and his duration of deafness was the longest. However, his speech discrimination results both in quiet and in noise were better than those for Participants 2, 3, 5 and 6. He obtained 10% speech discrimination in noise and a maximum of 28% speech discrimination in the quiet at 60dB. It is significant, however, that he was fitted with hearing aids at birth and has been using them ever since. He is also currently using a hearing aid in the contralateral ear to enhance his auditory skills.

Speech conveys meaning through words connected as sentences based on grammatical rules. The perception of speech is an important aspect of everyday life and is needed for successful oral communication interaction (Clark, 2003). LIPD adults do not obtain optimal open-set speech perception and cannot understand speech by audition alone. Their inability to perceive open-set speech, especially in the presence of noise, may influence their ability to attend to a talker while voices, footsteps, wind, and other sounds are present. Their progress after implantation may also be slowly (Zwolan, Kileny and Telian, 1996). The degree of benefit LIPD individuals receive from the cochlear implant is less than the benefit for postlingually deafened adults and therefore it would seem that it is not sufficiently rewarding to implant these candidates. Audiologist might use these results in the counselling process during candidacy. The prelingually deafened adult candidates and their families should be counselled regarding the possibility of limited speech understanding without speech-reading even after implantation (Shea, Domico & Orchik, 1990).

- **Speech discrimination in sentences**

The participants' ability to perform audition-alone, open-set speech discrimination of sentences was tested with the *Central Institute of the Deaf (CID) Everyday Sentence list* speech discrimination test. Words convey meaning and they are assembled according to the rules of the language as phrases or sentences. Meaning can be conveyed even if the person cannot recognize all the words in a sentence. Listeners are helped by their knowledge of grammar and the context of the conversation (Clark, 2003). Therefore, persons usually do better in speech discrimination in sentences than in speech discrimination of words, and for this reason a test that scores words recognized in sentences, as the CID Everyday Sentence list does, was used in addition to the word recognition tests. These tests are also routinely used as part of the pre- and post- implantation testing protocol.

LIPD implantees' ability to use (electrically coded) speech information for speech perception mostly differs from the ability of postlingual implantees to use the same information (Busby, Roberts, Tong & Clark, 1991) and poorer results are expected. Participants obtained varying degrees of sentence discrimination in an open-set setting and the results are presented in Table 4.4.

Table 4.4: CID sentence test results (n=6)

Participant no.	CID sentence discrimination		
	Intensity one	Intensity two	Intensity three
1	20% at 50dB	26% at 60dB	22% at 70dB
2	6% at 70dB	10% at 80dB	4% at 85dB
3	0% at 65dB	0% at 75dB	2% at 85dB
5	0% at 60dB	0% at 70dB	2% at 80dB
6	0% at 60dB	0% at 70dB	0% at 80dB
7	12% at 50dB	6% at 60dB	10% at 70dB

Participant 4 was again excluded from this test due to her inability to express verbally or in written format what has been heard. The results in open set sentence recognition reveal how difficult it is for prelingually deaf adults to recognize speech in the absence of visual cues. Varying degrees of benefit was observed and little or no benefit was again measured during the sentence discrimination test. Participant 6 could not obtain any sentence recognition, as was the case with word discrimination and speech-in-noise discrimination. Participant 7 could obtain a maximum of 10% sentence discrimination at 80dB. Participants 3 and 5 could only obtain 2% sentence discrimination at respectively 85dB and 80dB. Participants 1 and 7 obtained the highest sentence discrimination percentage, which was respectively 26% at 60dB and 12% at 50dB.

If biographical information is taken into consideration, it is evident that Participant 1 received her cochlear implant at the youngest age of all the participants, as previously mentioned. The shorter duration of deafness and the younger age of implantation therefore most likely have had a positive effect on her speech discrimination skills in sentences. It may therefore be concluded that her shorter duration of deafness and earlier age of implantation can be associated with better speech perception skills. This conclusion is supported by the literature, where it is stated that age at implantation and duration of deafness were found to have the most significant impact on post-implant outcomes (Wooi Teoh et al., 2004). Participant 7 performed better than Participants 2, 3, 5, and 6. The possible contributing factor to this participant's better speech discrimination in sentences is, as previously mentioned, the continuous auditory stimulation with hearing aids from birth and currently as an enhancement in the contralateral ear. Long duration of deafness, late age of implantation and limited auditory stimulation before implantation could be regarded as factors negatively influencing the speech discrimination in general of Participants 2, 3, 5, and 6.

It is also important to consider each participant's aided pure tone thresholds and speech discrimination results together, reflecting on audition-alone results. Participant 2's pure tone average falls within the normal range for cochlear implant users, but in general her speech discrimination of words and sentences are poor. The same results were observed for Participant 6. The pure tone average of Participant 3 was the poorest for the group, but still can be considered good in terms of pure tone results expected for a cochlear implant user. In contrast with her pure tone thresholds, her speech discrimination performance on word and sentence level is considerably poorer. Participant 5 obtained results similar to those of Participant 3. Participant 7 obtained a good pure tone average and although his speech discrimination performance was poor, he achieved a better score than Participants 2, 3, 5, and 6. Participant 1 obtained the best speech discrimination results for both words and sentences, but when compared to the typical scores of postlingually deafened cochlear implant users it is still poor. Her pure tone average fell the within normal range for cochlear implant users. The significant contrast between the pure tone threshold results and speech discrimination results for all the participants is related to the complexity of the signal. As mentioned previously, speech is considered a complex and linguistically loaded signal, which requires more complex processing skills, whereas pure tone signals are less complex and easier to detect (Clark, 2003). Prelingually deafened adult candidates should therefore be counselled that choosing implantation could result in a variety of outcomes that may greatly impact on an individual’s ability to communicate, work, and participate in recreational activities throughout daily life (Olson, 2006). The audiologist could use this information to inform prelingually deafened adult candidates that their thresholds for non-speech sounds can improve extensively with the cochlear implant and will be much better than when using the hearing aids, but that perception of speech sounds will not necessarily improve and if it does it will still be inadequate for independent functioning in a hearing world.

If the degree of benefit from a cochlear implant is defined simply by auditory speech discrimination testing, the results of this study indicate that the cochlear implant is not cost-effective and it could be concluded that prelingually deafened adults do not obtain significant benefit from the cochlear implant (Moody-Antonio, et al., 2005). However, auditory-only speech discrimination testing alone might not adequately reflect the benefit a LIPD adult could obtain from an implant. Visual speech perception is an important component of the speech and language skills of hearing-impaired individuals. It enhances hearing, and must therefore be included in determining the participants’ objectively assessed audiological outcomes.

4.3.1.3 Audition-plus-Vision Open-set Speech Test

Auditory-only speech discrimination testing might not adequately reflect the benefit a prelingually deafened adult could obtain from a cochlear implant. The use of visual information to supplement and enhance hearing, especially in challenging situations, is an important part of speech discrimination in LIPD adults and therefore visual speech discrimination, together with auditory speech discrimination, forms an important component of speech and language skills of this population. Visual cues are their most important source of language information (Moody-Antonio et al., 2005).

The results of the speech discrimination testing of words in quiet and noise, as well as speech discrimination of sentences in an audition-plus-vision, open-set speech environment are discussed in this section. The same procedures were followed and the same normative data used as with audition-alone, open-set speech discrimination testing. The data collected and summarized in Table 4.2, Section 5 will be discussed.

- **Speech discrimination results: Wordlists in quiet environment**

The results of the speech discrimination testing are presented in Figures 4.7 and 4.8.

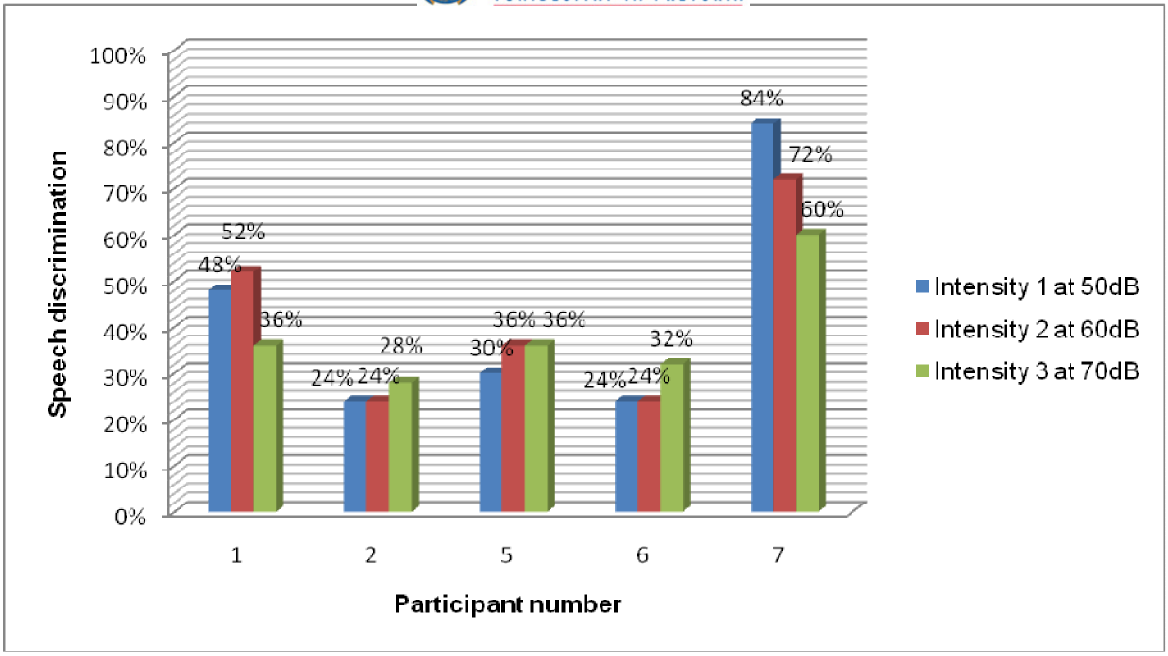


Figure 4.7: Audition-plus-vision speech discrimination results for wordlists in quiet: Participants 1, 2, 5, 6 and 7 (n=5)

As mentioned earlier, Participant 3's speech discrimination testing started at a higher intensity due to her higher pure tone average.

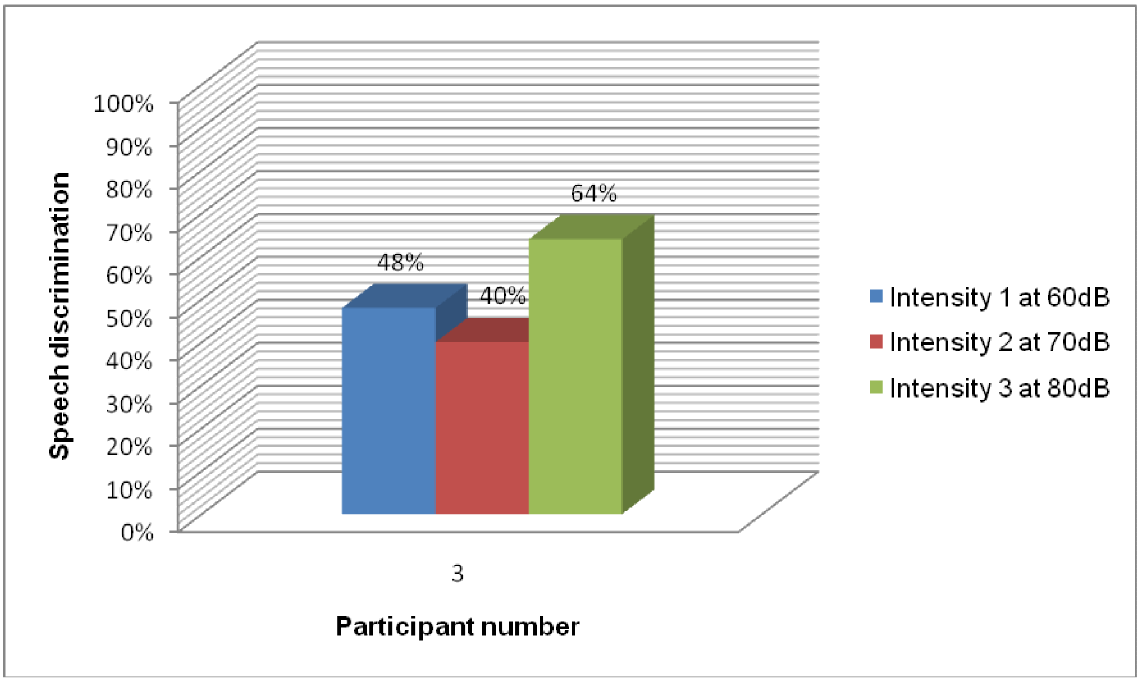


Figure 4.8: Audition-plus-vision speech discrimination results for wordlists in quiet: Participant 3 (n=3)

The results of their study led Moody-Antonio et al. (2005) to question the ability of individuals with extremely limited auditory experience to integrate auditory information from the cochlear implant with the visual speech information. In contrast, the current study showed that most of the LIPD adults displayed significant gains in the audition-plus-vision speech discrimination mode. The results depicted in Figure 4.7 and 4.8 made it apparent that improved speech discrimination in the audition-plus-vision mode was observed in the participants of this study. Participant 7 obtained a maximum of 28% audition-alone, open-set speech discrimination, but when visual cues were integrated with the auditory stimuli, he improved to a maximum of 84% open-set speech discrimination at 50dB. This can be regarded as a significant improvement in open-set speech discrimination. The improvement observed in the case of Participant 3 can also be regarded as significant. This participant obtained a maximum of 12% audition-alone open-set speech discrimination, but improved to a maximum of 64% audition-plus-vision open-set speech discrimination at 80dB. Participant 6 was not able to obtain any open-set speech discrimination with her auditory skills alone, but when visual information was combined with her auditory skills, her open-set speech discrimination skills improved to a maximum of 32% at 70dB. The audition-plus-vision open-set speech discrimination for Participant 6 is still not good, but the combination of signals at least provides her with a small amount of access to oral communication. Participant 5 obtained a maximum of 16% open-set speech discrimination in the audition-alone mode, but in the audition-plus-vision mode he obtained a maximum of 36% open-set speech discrimination. Participant 2's maximum auditory-plus-vision speech discrimination was obtained at 70dB with a percentage of 28% discrimination. An improvement of 20% speech discrimination was made from auditory-alone speech discrimination. Participant 1 obtained a maximum of 52% auditory-plus-vision, open-set speech discrimination in contrast to a maximum of 44% auditory-alone, open-set speech discrimination. Participant 1 presented with improved speech discrimination in the auditory-plus-visual mode, but not as significantly as the other participants.

The average speech discrimination ability of the participants, with the combination of auditory and visual cues, is 49%. The improvement from the 18% audition-alone speech discrimination to the 49% audition-plus-vision speech discrimination is significant. The speech discrimination of the LIPD participants with the use of audition-plus-vision can still be considered as poor, but it may provide these participants with more access to auditory-verbal communication.

- **Speech discrimination results: Wordlists in noisy environment**

The audition-plus-vision speech discrimination results of words in noise are presented in Table 4.2, Section 5.

Participant 3 and 7 both obtained a maximum of 50%, which was the highest speech discrimination of words in noise among the participants. Participant 3 improved from 0% speech discrimination in noise, with audition-alone, to 50% speech discrimination in noise when using both modalities. Participant 7 improved from 10% audition-alone speech discrimination in noise to 50% audition-plus-vision speech discrimination in noise. Participant 7 was, however, implanted at the latest age and the duration of deafness was the longest. These prognostic factors do not correlate with the expected outcomes of speech discrimination in noise. However, this participant utilizes a hearing aid in the contralateral ear. Results from research by Tye-Murray (2004) provide a possible explanation, namely that the use of two hearing aids or a cochlear implant in combination with a hearing aid can lead to better listening performance in noise than with a cochlear implant alone. The improvement in signal-to-noise ratio may be 2 or 3 dB and this phenomenon is called binaural squelch (Tye-Murray, 2004).

Participant 6 also improved with regard to speech discrimination ability in noise, when making use of both auditory and visual cues. She obtained 40% audition-plus-vision speech discrimination in noise, whereas no speech discrimination was possible without the visual cues. Participant 5 obtained 30% speech discrimination of words in noise in an audition-plus-vision mode. He also had 0% audition-alone speech discrimination in noise. The audition-plus-vision speech discrimination in noise for Participant 2 was 20% and improved from 0% audition-alone speech discrimination in noise. When considering the improvement these participants experienced in their audition-plus-vision speech discrimination in a quiet environment, the improvement in audition-plus-vision speech discrimination in noise can be regarded as positive as well.

Participant 1 did not improve in her speech discrimination in noise when using both modalities; in fact her speech discrimination ability decreased from 30% (audition-alone) to 20% (audition-plus-vision) speech discrimination in noise. This participant’s prognostic factors are more positive than the other participants’ due to her early implantation and shorter duration of deafness. It can therefore be considered that better audition-plus-vision speech discrimination in noise is not notably related to these prognostic factors.

Speech is corrupted by noise (Clark, 2003) and therefore it is to be expected that speech discrimination in noise will be poorer than speech discrimination in quiet. The presence of visual cues, however, could enhance the ability to communicate more effectively in background noise (Tye-Murray, 2004). The results obtained from the LIPD participants emphasized these findings and it was determined that the LIPD participants’ speech discrimination in noise was improved with the aid of visual cues together with the auditory stimuli. Based on these findings it was predicted that LIPD adults will obtain better speech discrimination when audition and vision are utilized. Optimal speech discrimination may still not be possible due to poor prognostic factors, such as long duration of deafness, late age of implantation and short period of implant use. The degree of benefit the LIPD adults receive is still less than the benefit postlingually deafened adults obtain and even though improved audition-plus-vision speech discrimination is expected, these adults are not good candidates for a cochlear implant. The audiologist, however, may use these results to contrast the expected outcomes for audition-alone against audition-plus-vision speech discrimination and counsel the candidates accordingly.

- **Speech discrimination of sentences**

To enhance speech perception, especially under difficult listening conditions, normal hearing and hearing-impaired adults will use both auditory and visual cues (Moody-Antonio et al., 2005). The LIPD adults in this study also used both these cues to enhance their communication in everyday situations. Varying degrees of sentences discrimination in audition-plus-vision mode were also observed and the results are presented in Table 4.2. Table 4.5 also provides a comparison between each participants' best sentence discrimination in audition-alone versus audition-plus-vision mode.

Table 4.5 Comparison between optimal audition-alone and audition-plus-vision sentence discrimination (n=6)

Participant no.	CID sentence discrimination	
	Audition-alone, open-set sentence discrimination	Audition-plus-vision, open-set sentence discrimination
1	26% at 60dB	54% at 60dB
2	10% at 80dB	40% at 60dB
3	2% at 85dB	98% at 75dB
5	2% at 80dB	40% at 70dB
6	0% at 80dB	24% at 70dB
7	12% at 50dB	64% at 60dB

Significant improvements in speech perception in terms of sentence discrimination were observed when auditory stimuli and visual cues were combined. Participant 3 obtained the highest audition-plus-vision sentence discrimination score namely 98% at 75dB. Referring back the biographical information, she was one of the participants who acquired her hearing loss at the age of three and therefore had speech and language experience for three years which could contribute to better speech perception if additional support, like visual cues, can be used. This participant had also been using her cochlear implant for more than three years, which means that the duration of implantation was longer than for most of the other participants. Participant 7, who was implanted at the latest age, and who had the shortest duration of implantation and the longest duration of deafness before implantation, also obtained significantly better audition-plus-vision sentence discrimination with a maximum of 64% at 60dB. It appears, therefore, that predictive factors are not always considerably correlated to better speech perception, especially when visual cues are added.

Participant 1 was implanted at an early age, with a long duration of implantation, and she obtained 54% sentence discrimination at 60dB. However, when considering her audition-alone sentence discrimination, the improvement in the audition-plus-vision sentence discrimination is not as impressive as for the other participants, but an improvement did occur. Participant 6 obtained a maximum of 24% sentence discrimination at 70dB, which cannot be regarded as good. She did, however, improve from 0% audition-alone sentence discrimination to the 24% audition-plus-vision sentence discrimination. The results imply that this participant has access to better communication when audition and vision are combined, which can be regarded as a good outcome for the individual.

Participants 2 and 5 both obtained a maximum of 50% sentence discrimination at respectively 60dB and 70dB. Both these participants demonstrated improved speech perception abilities when the auditory stimuli and visual cues were used. Participant 2 had a 30% improvement in her sentence discrimination when audition-plus-vision was used and Participant 3 obtained a 38% improvement under the same conditions.

The results obtained from the study done by Moody-Antonio et al. (2005) suggested that LIPD adults have a significant capacity for multimodal speech perception, and this was also found in this study. With the use of audition-plus-vision for speech discrimination of words and sentences, access to better speech perception is possible for LIPD adults but in comparison to the performance of postlingually deafened cochlear implant users, these results are still poorer than would be expected. The LIPD adults do not obtain optimal speech discrimination even when additional cues are used. The integration of the auditory stimuli and visual cues, however, provides the LIPD adults with more access to communication situations, especially in difficult listening conditions, with the implication that they might be included in society with more success. The findings may also enable the audiologist to inform possible candidates and their significant others regarding the differences in audition-alone and audition-plus-vision speech discrimination. Informed decisions can then be made, with the background knowledge of all possible outcomes in different modes of speech perception.

4.3.1.4 Vision-only Open-set Speech Test

According to Tye-Murray (2004), lipreading refers to the process of recognizing speech using only the visual speech signal and other visual cues such as facial expressions, whereas speech-reading is speech recognition using both auditory and visual cues. For the vision-only, open-set speech discrimination, the participants were expected to only make use of lipreading and not speech-reading. The results for speech discrimination of words and sentences in vision-only mode are presented in Table 4.2 and will be discussed in the ensuing paragraphs.

- **Speech discrimination of words**

The results of the speech discrimination of words are presented in Figure 4.9.

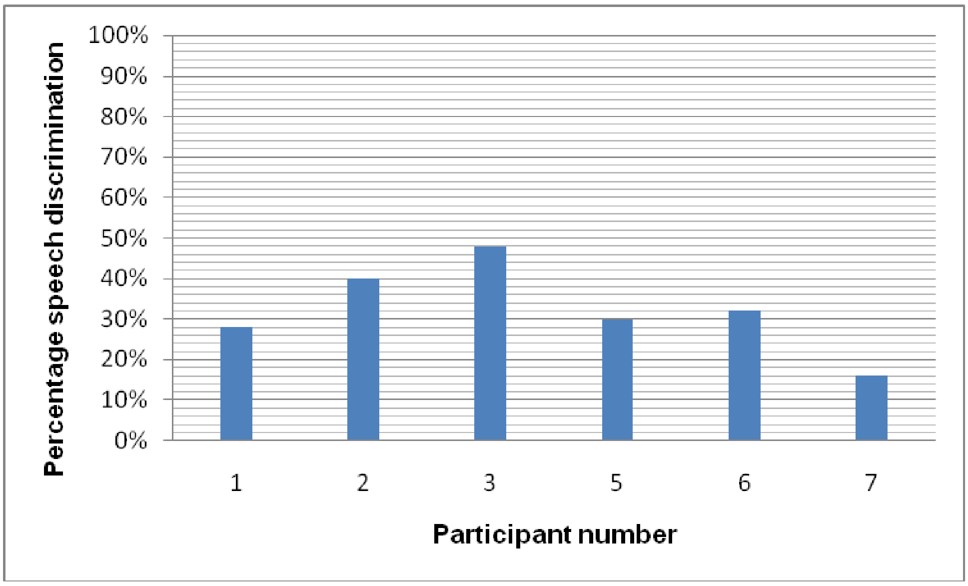


Figure 4.9. Vision-only speech discrimination results for words (n=6)

Divergent impressions regarding speech perception were obtained when vision-only speech discrimination was investigated. Participants 2 and 6 presented with better vision-only speech discrimination than with audition-alone and audition-plus-vision speech discrimination. These results are similar to the results found in the study by Moody-Antonio et al. (2005), where two participants also performed worse in the audition-plus-vision speech discrimination test than in vision-only. Taking into account the audition-alone speech discrimination of Participants 2 and 6, it can be concluded that their understanding of the auditory signal was so poor that it could contribute to the lower score obtained in the audition-plus-vision speech discrimination. Auditory-visual speech perception also requires complex central processing that incorporates transcription and integration of auditory and visual features, individual linguistic knowledge, individual memory and attention abilities, and understanding of context (Moody-Antonio et al., 2005). For cochlear implant users, especially those with little auditory experience such as Participants 2 and 6, this complexity could explain the finding of better vision-only speech discrimination than audition-plus-vision speech discrimination.

In contrast to the results obtained from these two participants, the other four participants' results indicated that auditory-visual speech discrimination produced a better score than vision-only speech discrimination. Participant 7 obtained the lowest vision-only results with 16 % speech discrimination. Participant 1 obtained 28% vision-only speech discrimination and it is fairly similar to the percentage obtained for audition-alone speech discrimination. Participant 3 obtained a relatively high vision-only score with 48% speech discrimination, but considering how well she did with auditory-visual speech discrimination, the difference between the vision-only and audition-plus-vision speech discrimination is noteworthy. Participant 3's audition-alone speech discrimination was significantly poorer than her vision-only speech discrimination, and these results emphasize her dependence on the visual cues in communication. Participant 5 obtained 30% vision-only speech discrimination and when comparing these results to his audition-plus-vision speech discrimination of 34% at 60dB, a small difference between the two modes of speech discrimination is noted. This participant's audition-alone speech discrimination was also poorer than his combined modalities of speech discrimination.

- **Speech discrimination in sentences**

People vary widely in their speech-reading performance. Some individuals can score 80% words correct or better on a vision-only test condition, as measured by verbatim repetition of test stimuli, whereas others score 5% or worse on the same stimuli (Tye-Murray, 2004). The same variability was observed in the LIPD participants. The results of vision-only sentence discrimination are presented in Table 4.2, Section 6, as well as a comparison between audition-alone, audition-plus-vision and vision-only sentence discrimination in Figure 4.10.

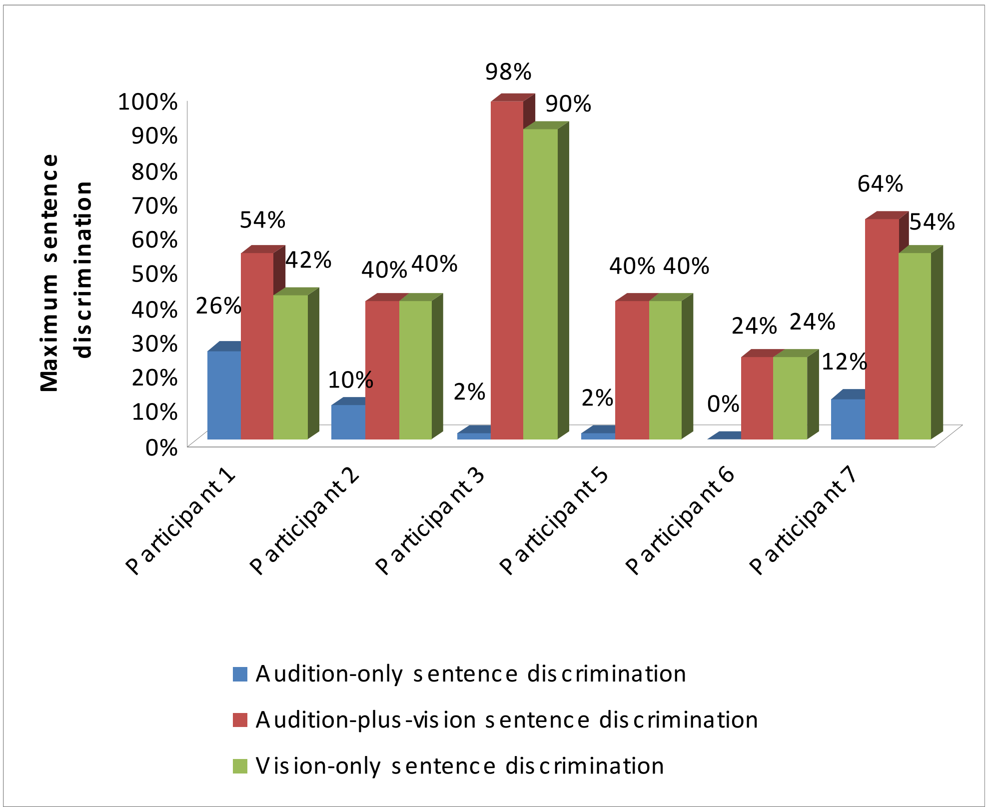


Figure 4.10 Comparison between audition-alone, audition-plus-vision and vision-only sentence discrimination (n=6)

Participant 3 obtained 90% vision-only sentence discrimination. When compared with the 98% audition-plus-vision sentence discrimination, it can be concluded that this participant makes use of mostly visual cues when speech discrimination is necessary, but that auditory stimuli contributed in a small degree to better speech perception. The same results were observed for Participants 1, 2, 5, 6 and 7, where the audition-plus-vision sentence discrimination and vision-only sentence discrimination were nearly the same percentage (audition-plus-vision sentence discrimination between 10% to 12% higher than the vision-only sentence discrimination, or the same percentage audition-plus-vision and vision-only sentence discrimination). It can therefore be concluded that the LIPD participants mainly make use of visual cues to enhance their speech perception, with little or no auditory support.

In summary, it is important to compare the audition-alone, audition-plus-vision and vision-only speech discrimination of the LIPD participants. It was observed that all the participants' audition-only speech discrimination of words and sentences are significantly poorer than their audition-plus-vision and vision-only speech discrimination. There were only minor differences in audition-plus-vision and vision-only speech discrimination. Four of the participants (Participants 1, 3, 5 and 7) did better in the audition-plus-vision speech discrimination tasks of words, whereas Participant 2 and 6 obtained the same percentage audition-plus-vision and vision-only speech discrimination on words, which indicates that they rely more on the visual cues provided during communication than on auditory stimuli. Similar results were obtained with speech discrimination of sentences. Participants 1, 3 and 7 obtained percentages for audition-plus-vision sentence discrimination that were slightly above the percentages obtained for vision-only sentence discrimination. Participants 2, 5 and 6 obtained the same percentage sentence discrimination in both audition-plus-vision and vision-only mode. Adults with normal- hearing can be expected to obtain 100% speech discrimination of words at an intensity of 30 dB HL or lower (Katz, 2002) and similar results are expected on the sentence discrimination tests (Katz, 2002). When comparing the results of the LIPD adults to the typically expected scores of normal- hearing adults, it is significant that the LIPD adults as a group do not perform well on open-set speech discrimination tasks, regardless of the mode (audition-only, audition-plus-vision or vision-only speech discrimination).

4.3.2 Self-reported audiological outcomes:

The results regarding self-reported audiological outcomes were obtained in Section B of the interview schedule (see Appendix B) and are summarized in Table 4.6. The self-reported audiological outcomes will be discussed under the following sub-headings: Hearing, speech-reading, and localization.

Table 4.6: Summary of all the self-reported audiological data (n=7)

Self-reported audiological results	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7
1. Hearing in everyday situations:							
Value of CI for listening:							
- **Crowded room**	Very helpful	Very helpful	Sometimes helpful	Never helpful	Very helpful	Very helpful	Very helpful
- **Small groups**	Very helpful	Very helpful	Very helpful	Never helpful	Very helpful	Very helpful	Very helpful
- **Television**	Very helpful	Very helpful	Very helpful	Never helpful	Sometimes helpful	Very helpful	Very helpful
- **Music**	Sometimes helpful	Sometimes helpful	Sometimes helpful	Very helpful	Never helpful	Sometimes helpful	Sometimes helpful

- **Radio**	Sometimes helpful	Never helpful	Never helpful	Sometimes helpful	Never helpful	Never helpful	Never helpful
- **One person**	Very helpful	Very helpful	Sometimes helpful	Never helpful	Very helpful	Very helpful	Very helpful
Recognition of environmental sounds:							
- **Telephone**	Always	Always	Sometimes	Always	Always	Always	Always
- **Doorbell**	Never	Sometimes	Always	Always	Always	Sometimes	Always
- **Door knocking**	Always	Sometimes	Always	Always	Always	Always	Sometimes
- **Car hooter**	Never	Always	Sometimes	Always	Always	Always	Always
- **Dog barking**	Always	Always	Sometimes	Always	Always	Always	Always
- **Baby crying**	Always	Always	Never	Always	Always	Always	Sometimes
- **Water running**	Always	Sometimes	Always	Always	Always	Always	Always
- **Footsteps**	Always	Always	Sometimes	Sometimes	Sometimes	Always	Always
- **Laughing**	Always	Always	Sometimes	Always	Always	Always	Always
- **Warning signals**	Always	Always	Sometimes	Always	Always	Always	Always
- **Car alarm**	Always	Always	Never	Always	Always	Always	Always
- **Alarm clock**	Always	Sometimes	Never	Always	Sometimes	Sometimes	Always
Speech information available: More with CI than with HA	Yes	Yes	No	No	No	Yes	Yes
Speech recognition over telephone:							
- **Family and friends**	Moderately proficient	Not able	Not able	Not able	Not able	Not able	Not able
- **Strangers**	Not able	Not able	Not able	Not able	Not able	Not able	Not able
2. Hearing in work/school/ place of study:							
Value of CI for listening:							
- **Lecturer/teacher in class**	Very helpful	Very helpful	Sometimes helpful	N/A	Sometimes helpful	Sometimes helpful	Sometimes helpful
- **Instructions**	Very helpful	Very helpful	Sometimes helpful	N/A	Very helpful	Sometimes helpful	Sometimes helpful
- **Meeting**	Sometimes helpful	Very helpful	Sometimes helpful	N/A	Sometimes helpful	Never helpful	Sometimes helpful
3. Hearing in social situations:							
Value of CI for listening:							
- **Small group friends**	Very helpful	Very helpful	Sometimes helpful	Never helpful	Very helpful	Very helpful	Very helpful
- **At a party**	Very helpful	Sometimes helpful	Sometimes helpful	Sometimes helpful	Sometimes helpful	Sometimes helpful	Very helpful
- **At a dance**	Very helpful	Sometimes helpful	Never helpful	Never helpful	Sometimes helpful	Sometimes helpful	Sometimes helpful
- **In a restaurant**	Sometimes helpful	Sometimes helpful	Sometimes helpful	Sometimes helpful	Sometimes helpful	Sometimes helpful	Sometimes helpful
- **In church**	Never helpful	Very helpful	Sometimes helpful	Sometimes helpful	Very helpful	Very helpful	Very helpful
4. Speech-reading:							

Speech-reading ability: - **Before implantation**	Excellent	Excellent	Average	Poor	Excellent	Good	Good
- **After implantation**	Excellent	Excellent	Good	Poor	Excellent	Excellent	Excellent
Ability to understand speech without speech-reading: - **In the same room**	Not able	Not able	Not able	N/A	Not able	Not able	Moderately proficient
- **Family and friends**	Not able	Not able	Not able	N/A	Not able	Not able	Not able
- **Strangers**	Not able	Not able	Not able	N/A	Not able	Not able	Not able
5. Localization:							
Localization ability with CI: - **Sound localization**	Moderate improve-ment	No improve-ment	Big improve-ment	Big improve-ment	Moderate improve-ment	Moderate improve-ment	Big improve-ment
- **Speech localization**	Moderate improve-ment	Moderate improve-ment	Moderate improve-ment	Moderate improve-ment	Moderate improve-ment	No improve-ment	Big improve-ment

4.3.2.1 Hearing

Self-reported outcomes related to the hearing function of a cochlear implant in different situations were determined. Consequently, hearing in everyday situations, hearing at work / school / place of study, and hearing in social situations will be discussed individually.

4.3.2.1.1 Hearing in everyday situations

Hearing in everyday situations examined the value of the cochlear implant in everyday listening situations, the participants' ability to recognize certain environmental sounds, and their self-reported ability to recognize speech. In addition, Figure 4.11 presents the self-reported benefit received from cochlear implant use.

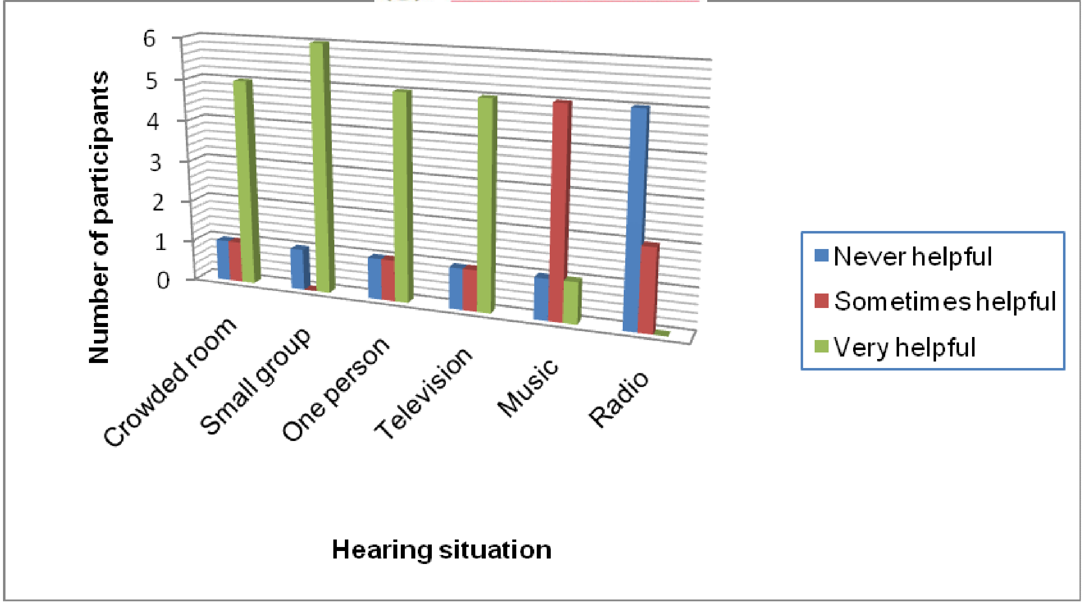


Figure 4.11: Self-reported benefit received from cochlear implant use (n=7)

Five of the seven participants (Participants 1, 2, 5, 6 and 7) indicated that they found the cochlear implant to be very helpful when listening to a conversation in a crowded room. Participant 4 felt that listening to a conversation in a crowded room is difficult and indicated that the cochlear implant is never helpful in these situations. Participant 3 indicated the cochlear implant is sometimes helpful in this type of situation. These results correlate with results from the study by Zwolan, Kileny and Telian (1996). In their study, most LIPD participants indicated that they find the use of the cochlear implant in a crowded room very helpful. IN the current study, six of the participants (Participants 1, 2, 3, 5, 6 and 7) indicated that the cochlear implant is very useful when listening in smaller groups is required. The participant with multiple disabilities (Participant 4), however, indicated that the cochlear implant is not helpful at all for listening in this situation. When considering these experiences of Participant 4, the lack of objectively assessed speech audiometric data is regretful. The results of the study by Zwolan, Kileny and Telian (1996) support the positive outcomes of the cochlear implant when listening in smaller groups. The participants in the current study (five out of the seven participants) also indicated that the cochlear implant is very helpful when listening to one person.

There were varying and diverse self-reported experiences concerning the benefit received from the cochlear implant when listening to the television, music and to the radio. When listening to the television, Participants 1, 2, 3, 6 and 7 experience that the cochlear implant provides optimal benefit and Participant 5 reported that the implant sometimes provides benefit in this situation. The benefit the cochlear implant provides when listening to the radio was not experienced as significant and five participants (Participants 2, 3, 5, 6 and 7) felt that it is never helpful in this situation, as indicated in Figure 4.11 and Table 4.5. It is essential to achieve open-set speech discrimination when listening to the radio, as the speaker cannot be seen and the listener cannot use cues like body language and facial expression or speech-reading to enhance the meaning of the message. For this reason, the LIPD adults experience problems when listening to the radio. The cochlear implant was also reported to be experienced as helpful for watching and listening to the television in the study of Zwolan, Kileny and Telian (1996). In the current study, the cochlear implant was experienced by the majority of the participants asonly sometimes helpful for listening to music. According to Zwolan,Kileny and Telian (1996), LIPD adults found music to be particularly enjoyable.

- **Non-speech sound hearing**

Satisfaction derived from a cochlear implant appears to be positively influenced by the participant's ability to recognize environmental sounds (Zwolan, Kileny & Telian, 1996). Figure 4.12 and Table 4.5 present the participants' self-reported ability to recognize environmental sounds.

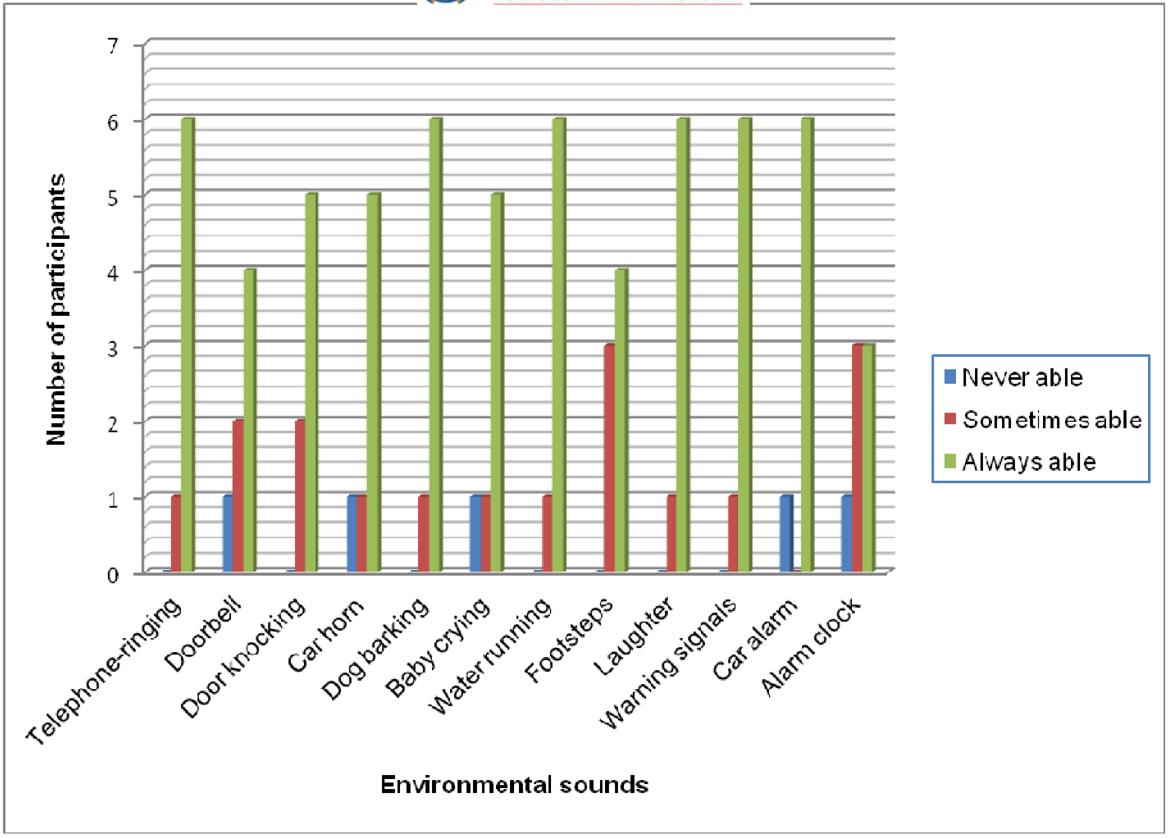


Figure 4.12: Ability to recognize environmental sounds (n=7)

All the participants indicated that their ability to recognize environmental sounds has improved and that they are better able to hear these sounds with the use of the cochlear implant. As reflected in Figure 4.12, all the participants reported that they were able to hear the following environmental sounds either sometimes or always: a telephone ringing, a dog barking, water running, footsteps, laughter, and warning signals/police sirens. Participant 7 reported that with the use of his cochlear implant, he is now able to hear his son's laughter. Participant 3 mentioned that he is now able to hear laughter when he is part of a group conversation.

The objectively assessed pure tone audiometry results support the self-reported results regarding the hearing of sounds. On the one hand, near-normal thresholds across the frequency range 250 to 4000Hz were determined for all participants, and on the other hand the participants reported that they were able to recognize more environmental sounds. The participants indicated that they were better able to recognize non-speech stimuli since the use of the cochlear implant. Although pure tone sounds and environmental sounds are not the same, both are not speech-related and less complex than speech (Katz, 2002).

One of the participants said: "*Ek hoor meer. Ek hoor goed wat ek nie voorheen kon hoor nie – omgewingsklanke" (I hear more. I hear things that I did not hear previously – environmental sounds).* This excerpt underscores the fact that the participant is able to hear more environmental sounds with the cochlear implant than previously without the implant.

The self-reported positive outcome regarding the recognition of environmental sounds could be an indication that cochlear implantation may be meaningful to these LIPD adults at least in their ability to hear non-speech sounds. These LIPD adults' ability to identify environmental sounds can be regarded as important (Clark, 2003), especially in everyday situations. The ability to recognize environmental sounds could contribute to better integration into society.

- **Speech hearing**

The participants' self-reported experience regarding their ability to understand speech presented through the cochlear implant varied. The results are represented in Figure 4.13.

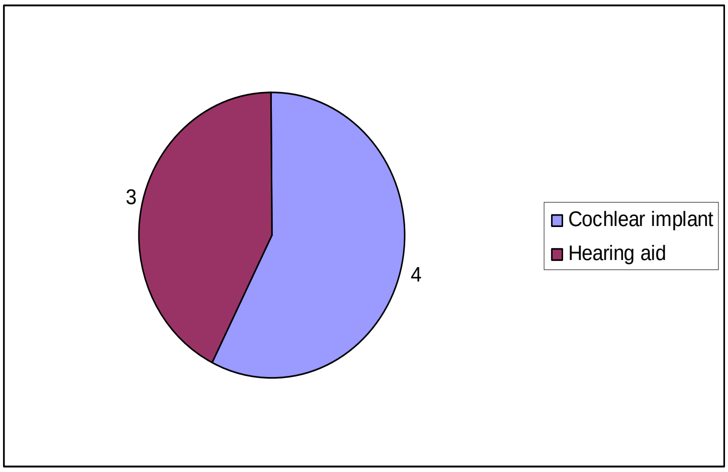


Figure 4.13: Ability to recognize speech information: Preference for the Cochlear Implant versus previously used hearing aid (n=7)

Three of the participants (Participants 3,4 and 5) indicated that they did not recognize more speech information via the cochlear implant than through their previously used hearing aids, whereas four participants (Participants 1, 2, 6and 7) indicated that they are indeed able to hear more speech information through their cochlear implant than they had ever experienced through their hearing aid. According to Clark (2003), a cochlear implant provides better speech discrimination than a hearing aid due to the fact that damaged hair cells are bypassed and better speech-processing strategies at higher frequencies are available. The cochlear implant also makes profoundly hearing-impaired persons comparable to people with less severe hearing losses who use hearing aids, due to the improved hearing abilities that the cochlear implant provides to the profoundly hearing-impaired person. It is important to mention- that the general feeling of the participants in this regard was that they cannot hear speech "all that well" with the cochlear implant. When the researcher explained, however, that the comparison was between the cochlear implant and the hearing aid, the above-mentioned results were obtained. In Zwolan, Kileny and Telian's (1996) study, the results indicated that the implant satisfaction in terms of the quality of speech was relatively low, which correlates with the less positive feeling of the participants towards their speech discrimination ability.

The last two questions under the subheading "hearing in everyday situations" examined the participants' experiences regarding telephone use. Figure 4.14 depicts participants' reported ability to understand family and friends, as well as strangers, over the telephone.

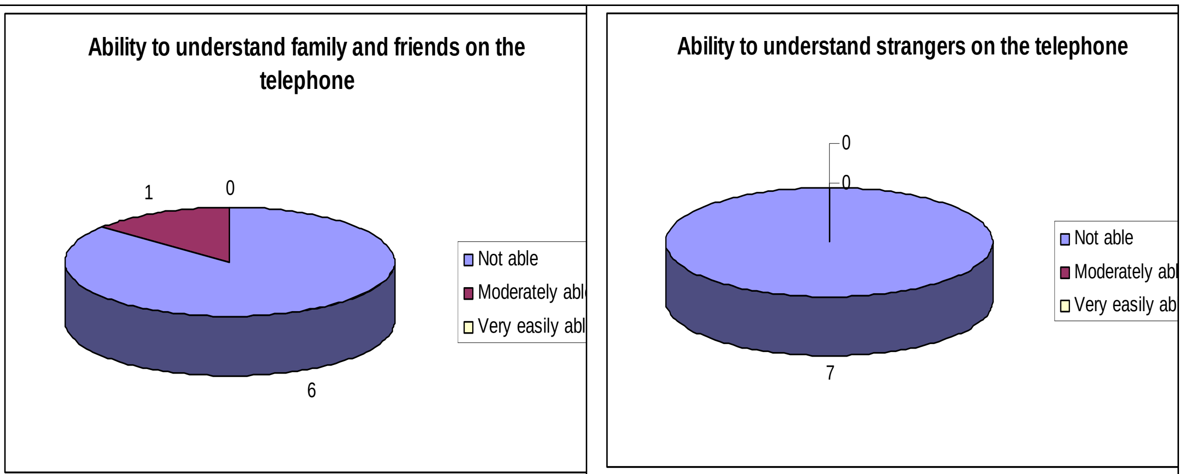


Figure 4.14: Ability to understand different speakers on the telephone (n=7)

As indicated in Figure 4.13, six of the seven participants (Participants 2, 3, 4, 5, 6 and 7) indicated that they are not at all able to understand their family and close friends on the telephone and none of the participants are able to understand a stranger on the telephone. These reported outcomes are in agreement with the results regarding their audition-alone open-set speech recognition skills, which provide an explanation for the problems that the implantees experience over the telephone. The LIPD adult cannot understand speech over a telephone due to the lack of visual cues, such as would be used in speech-reading, and the lack of context. In addition, telephones (landlines as well as mobile telephones) have a limited frequency range (300Hz – 3400Hz) (Tait, Nikolopoulos, Archbold & O'Donoghue 2001). Although the cochlear implant reproduces sound signals within a range of 200Hz to 7500Hz (Moore & Teagle, 2002), each sound has a unique set of frequencies and it is vital for speech understanding that an implant should not only be able to transmit a broad range of frequencies but should also have sufficient resolution for frequencies within that range so that the sound of the language can be identified (Hönck, 2004). The telephone's narrower bandwidth, together with the LIPD adults' poor audition-only open-set speech recognition, in all probability influence telephone use negatively as is evident from the current findings. Zwolan, Kileny and Telian (1996) came to the same conclusion, namely that a cochlear implant is not helpful at all when LIPD adults are conversing on the telephone, and that they are not able to understand anyone over the telephone. No information regarding using text messaging (SMS) was obtained. It is therefore evident that the telephone is not an optimal communication instrument for LIPD adults. According to Zwolan, Kileny and Telian (1996), late-implanted, prelingually deafened adults are able to recognize the dial tone, busy signal, phone ringing at the other end of the line, and someone answering at the other end.

Telephone use is part of daily life and an important tool for social and occupational exchange. It could also be necessary in emergencies (Clark, 2003) and in general, studies have found that the ability to communicate by telephone is very important for a cochlear implant user (Strauss-Schier & Rost, 1996). The results of the current study and previous research indicate that the use of the cochlear implant by the LIPD adult does not improve telephone communication. These adults, therefore, are not able to experience this integral part of adult life and do not comply with the expectations of modern society in this regard. Their work experiences may be influenced as they will not be able to receive or execute instructions given over the telephone. The results could be used by the audiologist during the counselling process, both pre- and post-implantation, in order to prepare the candidate regarding this imperfect outcome of cochlear implant use. Nevertheless, telephone training should be recommended. According to Strauss-Schier and Rost (1996), telephone training needs to be provided to all cochlear implant users regardless of their level of hearing skills. The aim might be just to enable the LIPD adult to hear familiar speakers better on the telephone.

4.3.2.1.2 Hearing at work / school / place of study

The value of the cochlear implant at work, school, or place of study was examined. It is important to note that Participant 4 was not working or studying due to her multiple handicaps and therefore no data regarding this aspect was obtained. Therefore, the data for this subheading will consist of only six participants' responses. The results of hearing at work, school, or place of study are represented in Table 4.6 and Figure 4.15.

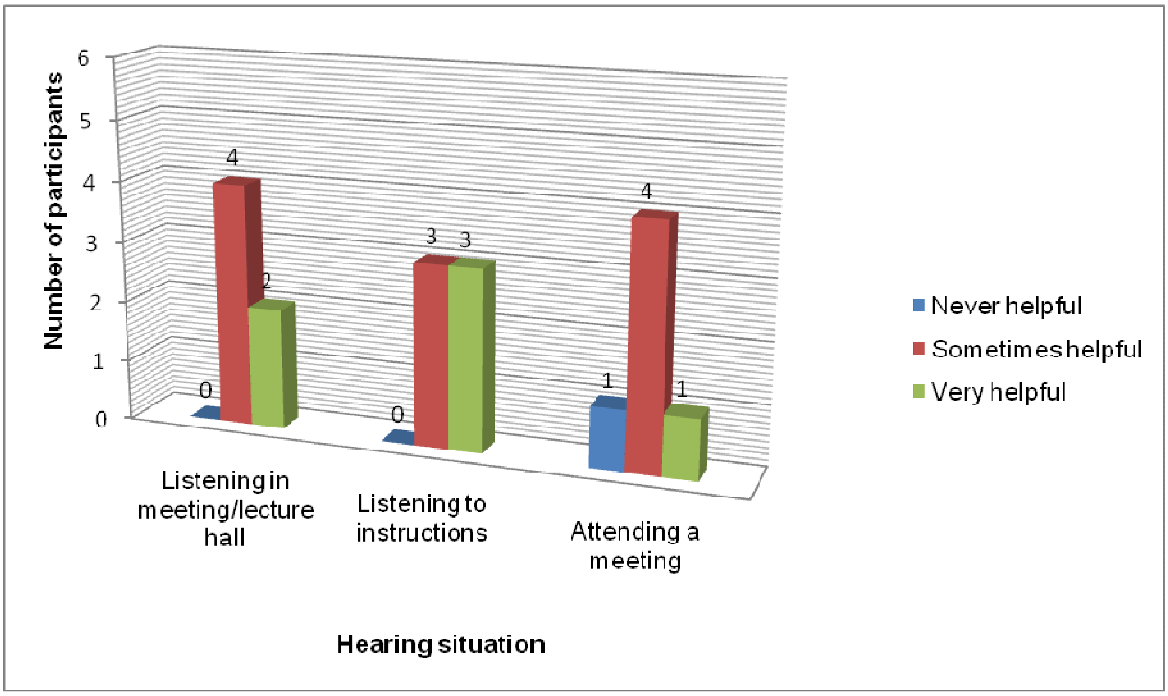


Figure 4.15: Self-reported benefit received from cochlear implant use at work, school, or place of study (n=6).

Four of the participants (Participants 3, 5, 6 and 7) indicated that they found the cochlear implant sometimes helpful when listening to a lecturer or speaker in a lecturing hall or meeting room. Only two participants (Participants 1 and 2) indicated that they experience the cochlear implant as very helpful in such a work situation. Zwolan, Kileny and Telian's study (1996) recorded the same type of responses in terms of the value of the cochlear implant when listening to a lecturer or speaker and therefore their results support the findings of this study. When receiving instructions from a supervisor, boss or lecturer, the cochlear implant was was experienced as either very helpful (Participants 1, 2 and 5) or sometimes helpful (Participants 3, 6 and 7). The participants' experiences regarding the usefulness of the cochlear implant when attending a meeting also varied. Only Participant 2 indicated that it was very helpful. Four participants (Participants 1, 3, 5 and 7) experienced it as "sometimes helpful" and Participant 6 never found it helpful. In Zwolan, Kileny and Telian's study (1996) the participants indicated that they were experiencing the use of the cochlear implant in work situations as positive.

Cochlear implants have enabled postlingually deafened adults to pursue or remain in their occupation of choice or to continue with their educational studies (Sanderson & Nash, 2001). This aspect also contributes to the cost-effectiveness of a cochlear implant. Although the cochlear implant device is more expensive than other assistive listening devices, the long-term savings to the community in job performance and education costs are very important (Clark, 2003; Sanderson & Nash, 2001). Hearing in the work place, school, or place of study is therefore very important and for the cochlear implant to be cost-effective it should influence the LIPD adults positively in their working environment. Based on the above-mentioned results, the self-reported positive outcomes in terms of work-related hearing skills also indicate that cochlear implantation could be meaningful for the LIPD population. As mentioned previously, hearing is important for successfuljob performance in the work-place, school, or place of study and if LIPD adults could use the cochlear implant for better work outcomes they might integrate into the work society with better results. The cochlear implant team and audiologist could also inform candidates regarding the work-related outcomes of cochlear implant use in order to aid them in informed decision making.

4.3.2.1.3 Hearing in social situations

Hearing in social situations was also determined by means of asking the participant to rate the helpfulness of the cochlear implant in certain social situations. Table 4.6 and Figure 4.16 represent the self-reported benefit received from cochlear implant use in social situations.

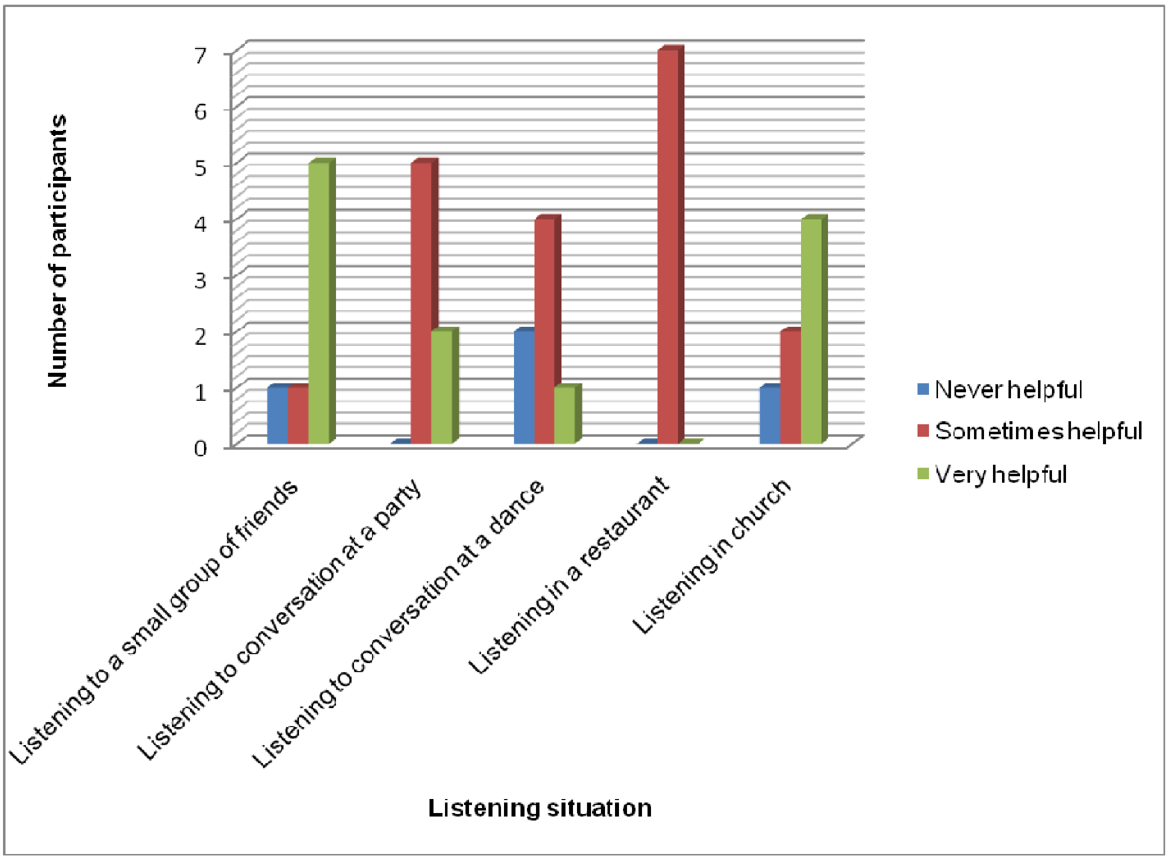


Figure 4.16: Self-reported benefit received from cochlear implant use in social situations (n=7).

The first social situation rated, was listening to conversation in a small group of friends. Five of the participants (Participants 1, 2, 5, 6 and 7) indicated that the use of the cochlear implant in this social situation is very beneficial. As mentioned previously, the results of the study by Zwolan, Kileny and Telian (1996) support these findings. Five of the participants (Participants 2, 3, 4, 5 and 6) indicated that the cochlear implant is only sometimes helpful when listening to conversation at a birthday party. Two participants (Participants 1 and 7) indicated that they experience listening with the cochlear implant as very helpful in this social situation. Use of a cochlear implant when listening to conversation at a dance was described by most participants as sometimes helpful (Participants 2, 5, 6 and 7), while two participants (Participants 3 and 4) indicated that they do not feel that it is helpful at all. Zwolan, Kileny and Telian (1996) reported that a few of the participants in their study mentioned that “loud sounds” and “too many noises” were their least favourite settings for listening with the cochlear implant. This could possibly be the reason why the participants in the current study indicated that listening at a dance is difficult and experienced as negative. All the participants indicated that using the cochlear implant in a restaurant is only sometimes helpful. Their experiences regarding the value of the cochlear implant in a church also varied. Two participants (Participant 3 and 4) indicated that it is only sometimes helpful, whereas four (Participant 2, 5, 6 and 7) experienced it as positive and only Participant 1 did not obtain any success with the cochlear implant in this situation.

The results as discussed above indicate that, overall, the LIPD adults experience their hearing in social situations as positive. It has been reported that individuals suffering from a severe to profound hearing loss often experience social difficulties, especially feelings of isolation; in contrast, individuals who have received an implant report fewer feelings of isolation and better social experiences (Tyler, Maillet & Jordan, 1995). The results of this study may indicate that due to the LIPD adults’ positive experience of the cochlear implant, they may present with better socioeconomic status and wellbeing, in the light of the outcomes for cochlear implants stated by Sanderson and Nash (2001). Implantation of the LIPD adults could therefore be meaningful according to these findings. Adequate hearing is essential for communicating in the hearing community and is therefore of great importance for all human beings (Clark, 2003). The ability of the LIPD adults to perceive sounds, especially speech, in social situations may contribute to better social functioning and better inclusion in the hearing world. This positive outcome may also be used by the audiologist to inform prelingually deafened adult candidates about the outcomes to be expected from a cochlear implant and could guide them to better decision making.

4.3.2.2 Speech-reading

The ability of cochlear implant users to understand speech without speech-reading is of great interest to researchers and clinicians involved in the rehabilitation of LIPD adults (Shea, Domico & Orchik, 1990). This sub-section, therefore, focused on the participants' speech reading before and after cochlear implantation, as well as on the participants' ability to understand speech without speech-reading in different contexts and speech situations. Table 4.6 and Figure 4.17 represent the results obtained.

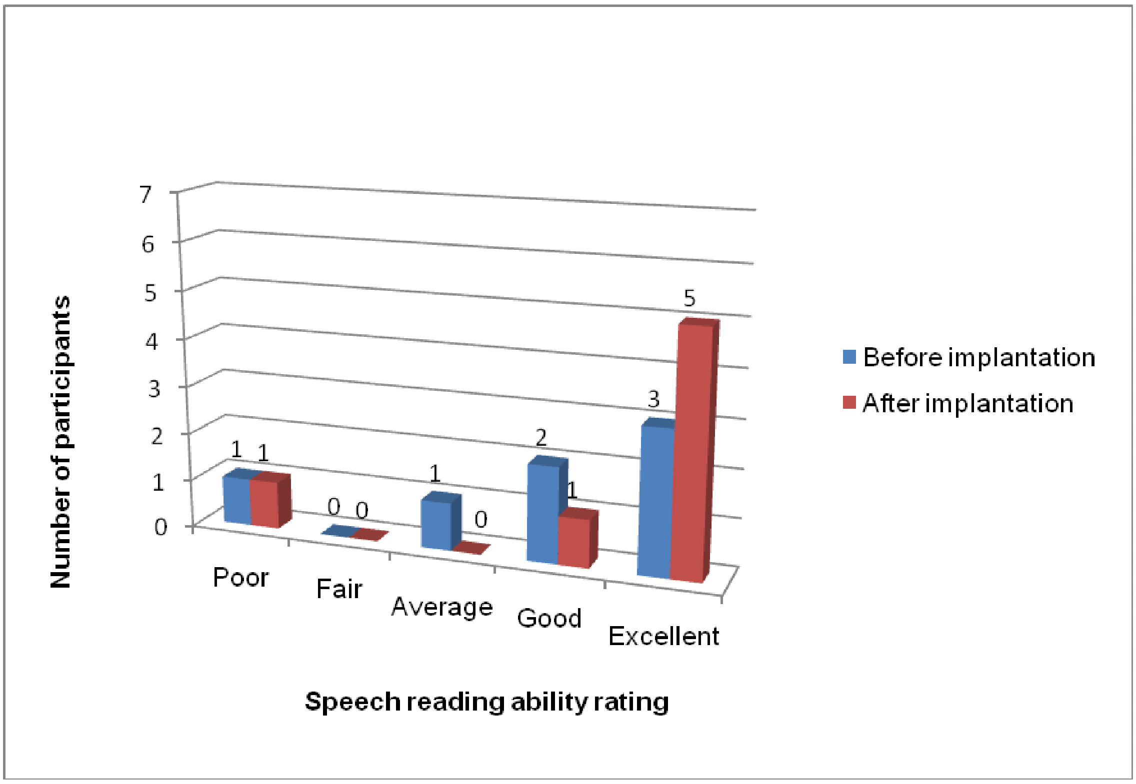


Figure 4.17: Speech reading ability before and after the implantation (n=7)

Participants 1, 2 and 5, who rated their speech reading abilities as excellent before implantation, maintained that it was still excellent after the cochlear implant. Participants 6 and 7 rated their speech reading abilities as good before the implantation, but indicated that after they had received their cochlear implant, their speech reading improved. Participant 3, who rated her speech reading as average before implantation, said it was good after the cochlear implant had been received. Participant 4 indicated that her speech reading abilities were poor both before and after implantation. When considering her visual disability, these results are to be expected. The general results are supported by research by Shea, Domico and Orchik (1990) and Manrique et al. (1994) who suggested that a specific benefit like improved speech-reading abilities can be achieved by LIPD adults.

In the study by Shea, Domico and Orchik (1990), the researchers indicated that the late-implanted, prelingually deafened adults may have limited speech understanding without speech-reading. For this reason, it was decided to examine the participants' self-reported experience regarding listening WITHOUT speech-reading. Participant 4 did not give responses regarding these three questions, due to her inability to speech-read. Only Participant 7 indicated that he can understand moderately well what one person is saying without speech-reading, especially when there are other people talking in the room. The rest of the participants cannot understand at all without speech-reading in this specific situation. All the participants also indicated that they could not understand their family and friends or strangers without speech reading. According to Moody-Antonio et al. (2005), prelingually deafened adults often use visual information to supplement and enhance hearing, especially in challenging situations. Visual speech perception is an important component of speech and language skills of hearing-impaired individuals and visual cues are the most important source of language information (Moody-Antonio et al, 2005).

Auditory-oral communication takes place when spoken verbal communication is received through hearing and speech-reading (Clark, 2003). Based on the results discussed above, the self-reported positive experiences regarding their speech-reading abilities indicate that speech-reading in combination with auditory input could add to the significance and meaningfulness of the implantation for these adults. Speech-reading will enable the LIPD adult to manage the hearing world better by means of using visual cues in addition to auditory input, and may consequently lead to better communication interaction and inclusion in the hearing world. The audiologist could also use these results for counselling purposes in order to prepare prelingually deafened adults candidates regarding the importance and necessity of speech-reading after implantation. Training in speech-reading should therefore be targeted in auditory rehabilitation, and the audiologist needs to prepare and encourage the prelingually deafened candidates to undergo extensive rehabilitation after implantation.

4.3.2.3 Localization

The two questions regarding localization focused on the participants ability to localize both sounds and speech. Table 4.6 and Figure 4.18 visually represent the results that were obtained.

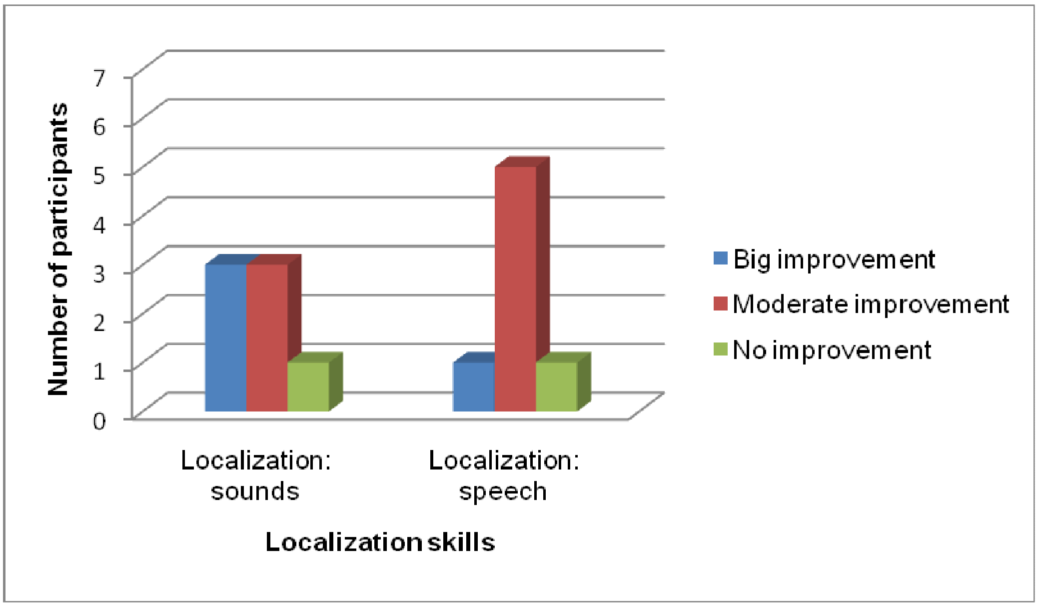


Figure 4.18: Changes in localization skills since the use of the cochlear implant (n=7).

Three participants (Participants 3, 4 and 7) indicated that their sound localization abilities improved greatly since they received their cochlear implants. Three participants (Participants 1, 5 and 6) indicated that their sound localization abilities improved only moderately, and Participant 2 indicated that sound localization ability has not improved. The participants' speech localization abilities were reported on as follows: five participants (Participants 1, 2, 3, 4 and 5) reported moderate improved since the cochlear implant. Participant 7 felt that his speech localization has improved greatly since the use of the cochlear implant. This is the only participant making use of both a cochlear implant and a hearing aid. When both ears are stimulated together there is typically an improvement in the ability to localize sound (Clark, 2003). Participant 6 has not experienced any improvement in her speech localization since receiving the cochlear implant.

At the conclusion of Section B of the interview, an open question about their feelings regarding auditory functioning was presented. All the participants reported positive experiences regarding the cochlear implant. Three participants

(Participants 5, 6 and 7) particularly mentioned that the cochlear implant provided them with more benefit than the hearing aid. All of them also noted that they are now able to hear more sounds and that they are able to use the cochlear implant when listening to speech. Participant 3 said the following: *"… ek hoor beter, kommunikeer makliker. Ek het leer praat en luister; ek het 'n normale lewe." (… I hear better, communicate more easily. I learnt to speak and listen; I have a normal life.)* This quote illustrates the effect of the cochlear implant on this LIPD adult's life and indicates that the use of the cochlear implant contributes to better auditory functioning. Significant improvements in their self-reported auditory skills, in terms of detection and identification of environmental sounds, as well as improvement in their speech-reading skills were reported. These findings are supported by the literature (Zwolan, Kileny & Telian, 1996; Moody-Antonio, et al., 2005).

4.4 Communication-related language outcomes – Description and discussion of results for sub-aim 2.

Most LIPD patients obtained language equivalent age scores well below their chronological ages at all pre- and postoperative evaluations, which indicated that language skills were considerably delayed (Dawson, Blamey, Dettman, Barker & Clark, 1995). However, although this population demonstrated little or no improvement in their speech recognition after implantation, they did report that using the cochlear implant improved their receptive and expressive communication skills (Zwolan, Kileny & Telian, 1996). To investigate all aspects of communication-related language skills, both objectively assessed and self-reported communication-related language outcomes were taken into consideration.

4.4.1 Objectively assessed communication-related language outcomes

It is well known that an important relationship exists between speech perception and language (Clark, 2003). Not only does better speech perception result in better language performance, but improving language performance will affect speech perception positively.

Table 4.7 list the results obtained from the Afrikaanse Reseptiewe Woordeskattoets, which was used to the participants' receptive language.

Table 4.7: Afrikaanse Reseptiewe Woordeskattoets (receptive language) (n=6)

Receptive language	**Participant number**						
	1	**2**	**3**	**5**	**6**	**7**	**Mean**
Chronological age (in years and month)	20.08	25.01	26.09	29.06	30.0	36.0	28.0
Age equivalent (in years and months)	6.0	6.0	7.06	6.0	7.07	6.09	6.06
Difference between chronological age and receptive language age (in years and months)	14.08	19.01	19.03	23.06	22.05	29.03	21.03

The language test consisted of pictures that needed to be identified by pointing in response to a word spoken by the examiner. Due to participant four's inability to see, no results could be obtained. Participant 1 was 20 years and 8 months of age, but presented with a 6 year receptive vocabulary age level. Participant two's chronological age was 25 years and 1 months and her receptive vocabulary was at a 6 year age level. Participant three's chronological age was 26 years and 9 months, but she has a receptive vocabulary at a 7.07 year age level. Participant 5 is 29 years and 6 months old, but presented with a receptive vocabulary of a 6 year age level. Participant six's chronological age was 30 years with a receptive vocabulary at a 7.07 year age level. Participant 7 is 36 years of age, with a receptive vocabulary age level of 6.09 years. The difference between chronological ages and receptive vocabulary age equivalent level was significant in every case. Differences of between 14.08 years and 29.03 years were obtained.

Substantial delays in receptive language have been found to occur as a result of prelinguistic or early onset deafness (Dawson et al., 1995), and this was evident in the results obtained from the participants. The early onset of deafness and the long duration of deafness before the implantation have influenced this population's receptive language abilities negatively.

Table 4.8 lists the Clinical Evaluation of Language Functions (CELF) results obtained from each participant. The CELF assessed the following aspects: production of a word series and production of names on confrontation (rapid automatic naming), production of word associations (ability to recall names of members of a semantic class) and production of formulated sentences (ability to formulate compound and complex sentences). The first two categories assessed the participants' ability to name basic concepts such as the days of the week, months of the year, colours and shapes. The last two categories assessed word finding abilities (vocabulary) and expressive syntax.

Table 4.8: Clinical Evaluation of Language Function (CELF): Expressive language (n=6)

Clinical Evaluation of Language Function: (Expressive language)	Participant number					
	1	**2**	**3**	**5**	**6**	**7**
Production of word series:						
Fluency:	Not age appropriate	Age appropriate	Age appropriate	Age appropriate	Not age appropriate	Not age appropriate
ERROR:	Transposition				Repetition	Repetition
Duration:	Age appropriate	Age appropriate	Age appropriate	Age appropriate	Age appropriate	Age appropriate
Production of names on confrontation:						
Fluency:	Not age appropriate	Age appropriate	Age appropriate	Age appropriate	Age appropriate	Age appropriate
ERROR:	Substitutions & Omissions					
Duration:	Age appropriate	Age appropriate	Age appropriate	Age appropriate	Age appropriate	Age appropriate
Production of word associations:						
Age appropriate:	No	No	No	Yes	Yes	No
Grade level:	Grade 4	Grade 7	Grade 8			Grade 7
Production of formulated sentences:						
Age appropriate:	No	No	No	No	No	No
Grade level:	Preschool	Grade 3	Grade 5	Preschool	Grade 5	Grade 5

According to Table 8, three of the participants (Participants 2, 3 and 5) were able to produce the days of the week and the months of the year with appropriate fluency and within normal duration. The other three participants (Participant 1, 6 and 7) experienced problems with either the days of the week or the months of the year in terms of the fluency of the production. Participant 6 and 7 repeated a word in the word series and the error observed with Participant 1 was the transposition of words. It is important to note, however, that these three participants' scores were appropriate in terms of duration.

Five of the participants (Participants 2, 3, 5, 6 and 7) were able to produce the names of the colours and shapes and the combination of the two on confrontation with appropriate skill regarding both fluency and duration. Participant 1, however, did not obtain age appropriate scores for the production of a combination of shapes and colours on confrontation in terms of fluency. She presented with substitutions of the names, as well as omissions of words. She could, however, produce the names within the norm duration.

For the category of production of word associations, four of the participants (Participants 1, 2, 3 and 7) obtained scores below age appropriate level. Participants 2 and 7 were functioning on a grade seven school-age level, which is equivalent to approximately 13 years of age. Participant 3 obtained a score at a grade eight level, which is equivalent to an age of approximately 14 years. Participant 1 was functioning on a grade four level, which is equivalent to approximately 10 years of age. Participants 5 and 6 obtained age appropriate scores.

The relationship between language comprehension (receptive language) and production (expressive language) is one of mutual dependence. The development of comprehension prior to production is usually considered a universal of language functioning (Owens, 2001). If the receptive vocabulary scores and the production of word associations (expressive vocabulary) are compared, a discrepancy in the scores is observed. It is important to note that the CELF subsection "Production of word associations" only assessed vocabulary regarding food and animal categories, and therefore does not represent all the different word types in the Afrikaans language. This subsection of the CELF was used, however, due to the lack of an appropriate expressive vocabulary test in both the English and Afrikaans languages. The results of the two sub-sections can therefore not be compared, but must be interpreted separately.

According to the last subsection of the CELF, namely the production of formulated sentences, all the participants obtained scores far below their chronological ages. Participants 3, 6 and 7 obtained the highest scores that indicated functioning on a grade five school-age level, which is equivalent to 11 years of age. Participant 2 obtained a grade three level score and this is indicative of a 9 year-old level. Participants 1 and 5 obtained a preschool level, which is equivalent to a five-to-six year old age. As was the case with the receptive language scores, the participants' expressive language scores are significantly below the scores expected on the grounds of their chronological ages.

The typical characteristics of the participants' formulated sentences were as follows:

- *Complexity of sentences:* The participants mostly made use of simple sentences containing a subject, verb and object. At the most, simple sentences with a phrase were provided.
- *Types of sentences:* All the participants were able to produce different types of sentences. Interrogative, negative and declarative sentences were observed.
- *Grammar:* Grammatical errors occured often in their speech. According to Clark (2001), grammatical morphemes are difficult for deaf children to recognize and produce. It is evident that prelingually deafened adults using a cochlear implant also experienced problems with this aspect of language.

- *Types of words:* The LIPD adults also had difficulties with the recognition and use of certain word types. Four of the participants could not understand the abstract verb "behoort" (should) and could not formulate a sentence containing the word. The Afrikaans pronoun "haarself" (herself) also was often misunderstood.

Early-deafened children, and consequently also adults, have significant delays in communication, which includes vocabulary and grammar (Clark, 2003). The speech perception results of these participants are in accordance with the results of research by Clark (2003) - the poorer speech perception of LIPD adults correlated with their poor language skills. In the current research, the LIPD adults' poor speech perception scores are associated with poor receptive and expressive language skills.

The lack of early auditory experience and the mode of communication influence the LIPD adults' linguistic knowledge, concerning both receptive and expressive language, negatively (Skinner et al., 1992). The objectively assessed receptive and expressive language results seemed to indicate that that cochlear implantation in the LIPD population may not be worthwhile, due to very poor oral language skills post-implantation. Oral language is the basis for communication between people in the hearing world (Clark, 2003) and therefore constitutes an important aspect of life and successful social interaction. The LIPD adults do not have optimal receptive and expressive language skills, and this may influence their ability to understand all the words and sentences in a conversation. It may also decrease the intelligibility and meaning of words and sentences they use to communicate and participate in conversations. The audiologist might use these findings during the counselling process in order to prepare both the candidates and their families regarding the probability that poor language skills will not improve much after implantation. The first six years of life is the critical time when speech and language skills of normally hearing children develop rapidly. For a hearing impaired person, early intervention with appropriate hearing prosthesis and intensive training during that period of life may be critical for learning language effectively. The LIPD adults did not have either of these necessary aspects for optimal language learning and therefore extensive learning of new language may not occur after implantation (Dawson et al., 1995). Auditory rehabilitation may be initiated after implantation to address language skills in terms of the expansion of vocabulary and language structures, but the LIPD adults must be counselled about the limited outcomes that may be expected.

4.4.2 Self-reported communication-related language outcomes

The results regarding the self-reported communication-related outcomes were obtained in Section C of the interview. The self-reported language outcomes will be discussed under the sub-headings: Language in everyday situations, language at work / school / place of study and language in social situations. Results are summarized in Table 4.9.

Table 4.9: Summary of all the self-reported language data (n=7).

Self-reported language results	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7
1. Language in everyday situations							
"Are you able to make yourself understood to strangers without using gestures?"	Always	Never	Mostly	Never	Sometimes	Sometimes	Mostly
"Since you received your CI, do you feel your comprehension/understanding of spoken language has improved or decreased?"	No change	Increased	Increased	Increased	Increased	Increased	Increased
"Do you feel that the amount of words that you use (your vocabulary), since you received your CI, have increased or decreased?"	Increased	Increased	Increased	Increased	Increased	Increased	Increased
"Since you received your CI, do you feel that the complexity of sentence structures that you use has increased or decreased?"	Increased	Increased	Increased	No change	Increased	Increased	Increased
2. Language at work/ school/ place of study							
"Do you communicate							

effectively in a situation where you are talking with someone in the office, lecture hall or in the classroom?"	Always	Always	Mostly	Not applicable	Mostly	Sometimes	Sometimes
3. Language in social situations							
Which of the following statements describe your communication abilities before, and after implantation?" - **Find that communication is very tiring and effortful**	No difference	Before implantation	After implantation	Before implantation	Before implantation	Before implantation	After implantation
- **I feel comfortable in company during communication**	After implantation	After implantation	After implantation	After implantation	After implantation	After implantation	After implantation
- **I can follow a conversation more easily**	No difference	After implantation	No difference	After implantation	After implantation	After implantation	After implantation
"Since you received your CI, to what extent has your implant reduced the help needed from other people when communicating in social activities?"	Moderate reduction	No reduction at all	Moderate reduction	No reduction at all	Moderate reduction	Moderate reduction	Moderate reduction

4.4.2.1 Language in everyday situations

This section "Language in everyday situations" examined oral language without gestures, self-reported receptive language, self-reported expressive vocabulary and complexity of sentence structures. The results for the first aspect are visually represented in Figure 4.19.

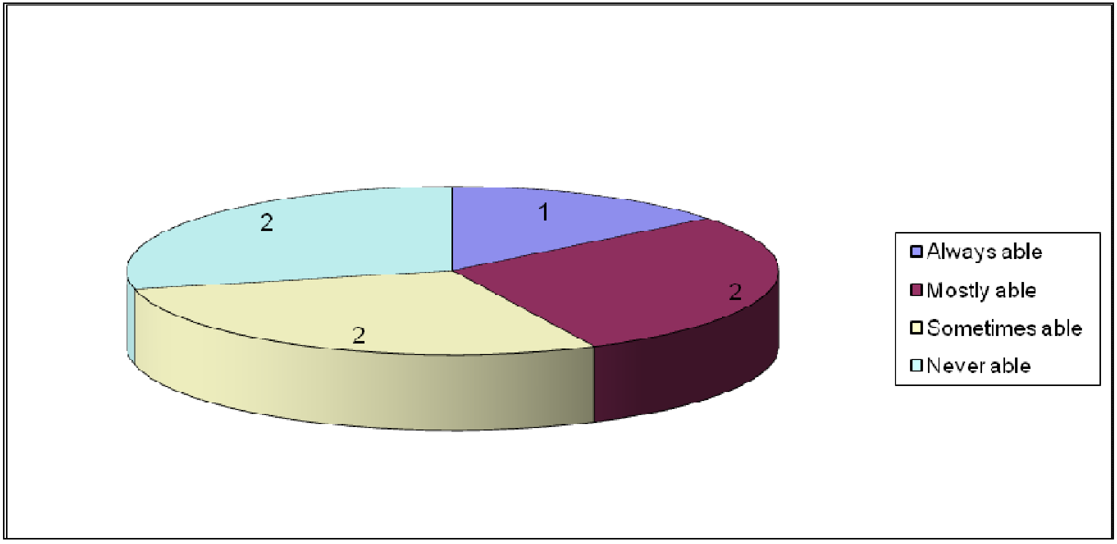


Figure 4.19: Ability of the participants to make themselves understood without gestures (n=7).

Two participants (Participants 2 and 4) indicated that they are never able to express themselves to strangers without the use of gestures, even after the cochlear implant was received. Two participants (Participants 5 and 6) indicated that they are sometimes able to express themselves without gestures and two other participants (Participants 3 and 7) are mostly able to make themselves understood without gestures. Participant 1 indicated that she could communicate without gestures. The use of total communication may contribute to weaker development of speech perception, which can be reflected in poorer language skills (Sarant, Cowan, Blamey, Galvin & Clark, 1994). The results of the interview indicated, however, that the majority of the participants experienced that they are able to communicate without gestures, although not consistently.

Figure 4.20 presents the change in terms of language areas as perceived by the LIPD participants.

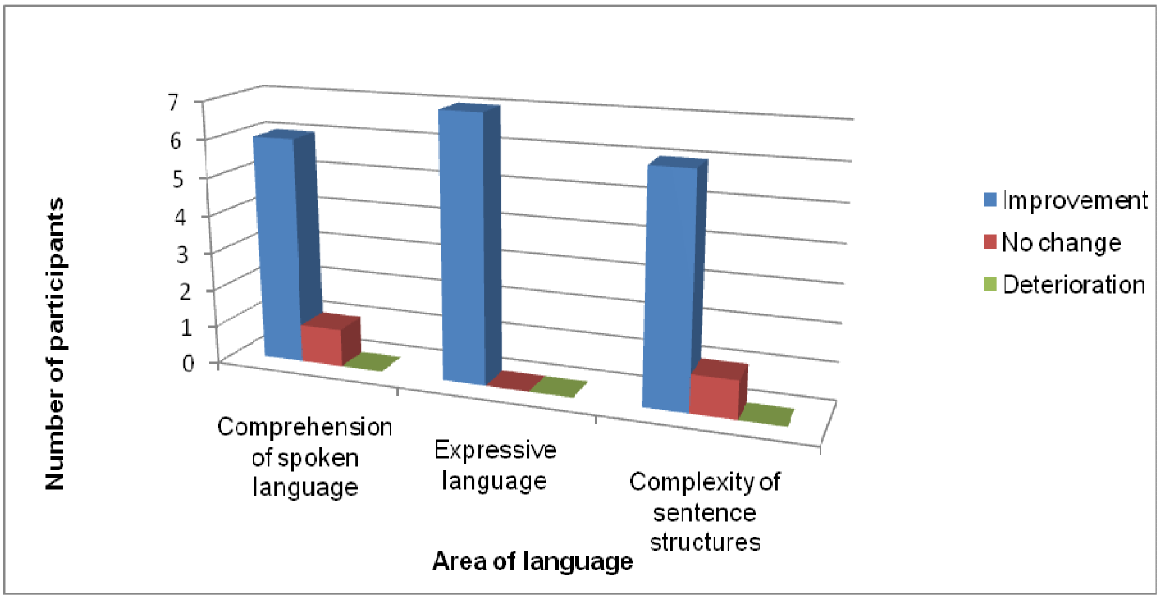


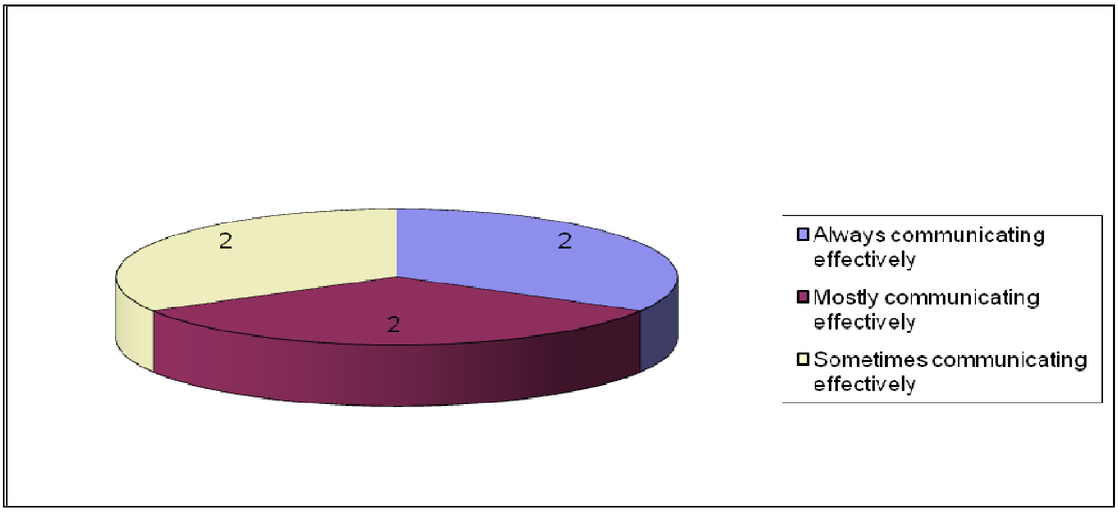
Figure 4.20: The change in terms of language areas as perceived by the LIPD participants (n=7).

The results depicted in Figure 4.19 reveal that the majority of the participants (Participants 2, 3, 4, 5, 6 and 7) experienced that their comprehension of spoken language improved since receiving the cochlear implant. All the participants indicated that their expressive vocabulary expanded with the use of the cochlear implant. Six participants (Participants 1, 2, 3, 5, 6 and 7) also experienced that the complexity of their sentence structures increased. These results correlate with the results obtained by Zwolan, Kileny and Telian (1996), namely that most LIPD adults reported that using the cochlear implant improved both their receptive and expressive communication and language skills.

In summary, the LIPD adults experienced that both theirreceptive and expressive language skills in everyday life have improved, and this can be regarded as a self-reported positive outcome. These results place the outcomes of the cochlear implant for LIPD adults in a somewhat more optimistic light, and indicate that the cochlear implants for this population could be meaningful. Appropriate language skills facilitate successful communication in everyday life. Viewed objectively, the LIPD adults may not have appropriate language levels, but their self-reported experiences indicate that improvements in both receptive and expressive language were observed by them. The self-reported improvement in their language skills could mean better communication in everyday life and could contribute to better integration into society. The audiologist could also use these results to inform and counsel prelingually deafened candidates regarding these positive experiences relating to language, and help them to evaluate all the different aspect of cochlear implant appropriately. In addition, the audiologist should also encourage post-implantation rehabilitation to work towards improvement in all areas of language.

4.4.2.2 Language at work / school / place of study

Questions in this sub-section "Language at work, school, or place of study" obtained information regarding communication in an office, classroom, or lecture hall. Figure 4.21 displays the results.



* Participant 4 does not communicate in any of these settings, therefore no results were included for this participant

Figure 4.21: Communication effectiveness in the office, lecture hall or in the classroom (n=7).

The participants all experienced effective communication in these settings, but to varying degrees. Two participants (Participants 1 and 2) reported that since receiving the cochlear implant, they are always able to communicate effectively in these settings. Two participants (Participants 3 and 5) indicated that they mostly communicate effectively, whereas two other participants (Participants 6 and 7) felt that they are only sometimes able to communicate effectively in these settings. Participant 4 does not communicate in any of these settings and therefore no response could be obtained.

The literature documents that prelingually deafened cochlear implant users reported enhanced communication skills when using the implant, even users who did not show improvement on speech recognition scores (Moody-Antonio et al., 2005).

4.4.2.3 Language in social situations

This aspect of Section C obtained information regarding the participants' communication abilities before and after implantation, as well as regarding the help that the participants need in order to communicate, since the use of the cochlear implant. The results are displayed in Figure 4.22.

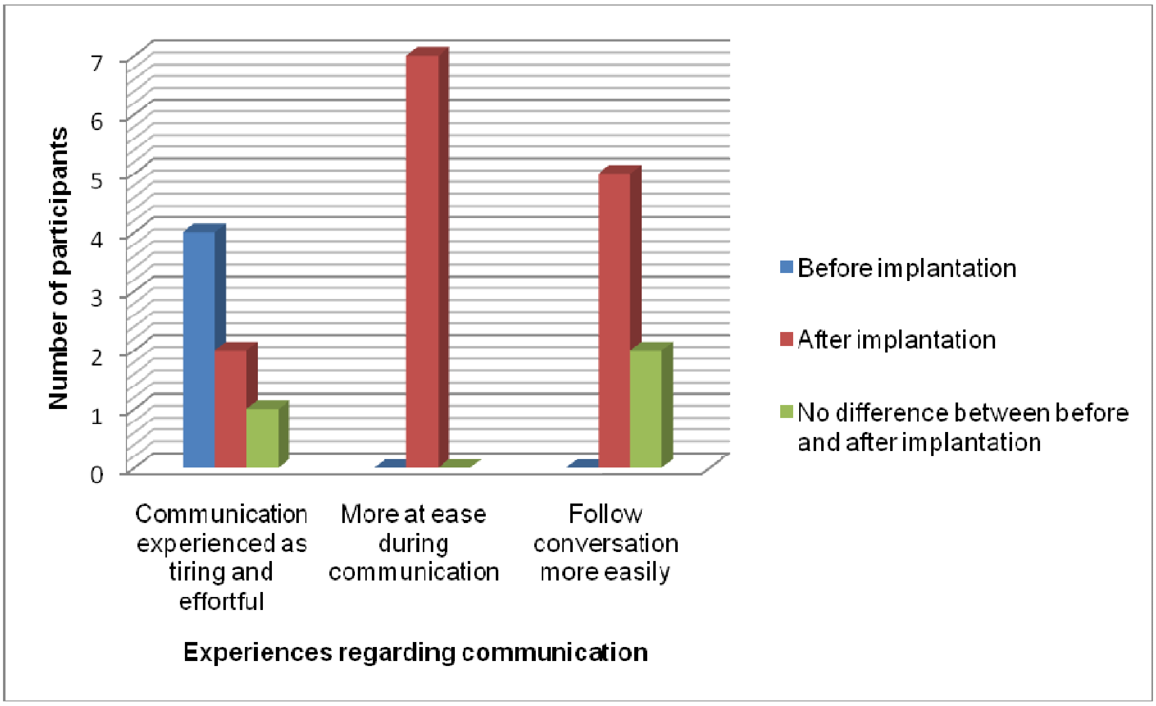


Figure 4.22: Self-reported experiences regarding communication abilities before and after implantation (n=7).

According to Schramm et al. (2002), prelingually deafened adults perceived that their communication skills improved with the use of the cochlear implant. This perception was also evident with most of the participants in the current study. Four participants (Participants 2, 4, 5 and 6) reported that they experienced communication as tiring and effortful before the implantation, and all the participants indicated that since the cochlear implant is being used, they feel more at ease when communicating. Most of the participants (Participants 2, 4, 5 and 7) also reported that they are able to follow a conversation more easily since receiving the cochlear implant.

The reduction in help needed when communicating in social activities, was experienced as represented in Figure 4.23.

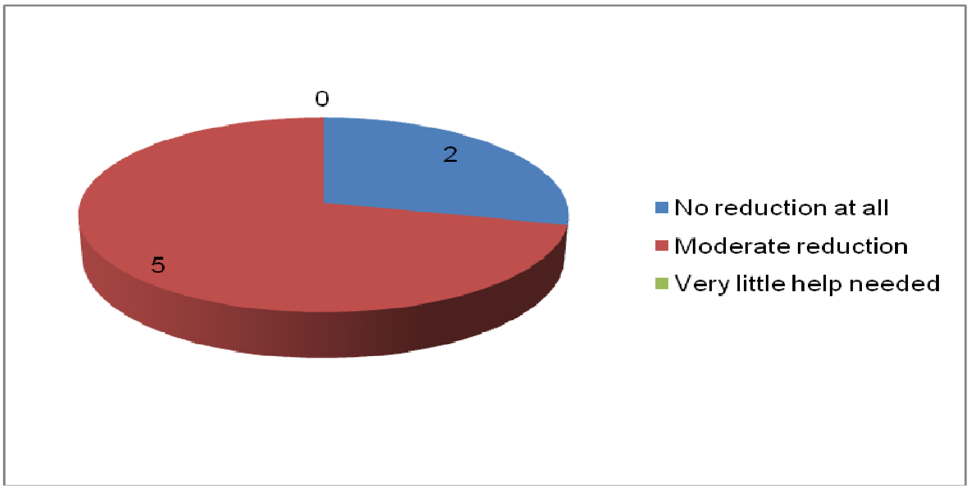


Figure 4.23: Reduction in help needed when communicating, since the use of the cochlear implant (n=7).

Five participants (Participants 1, 3, 5, 6 and 7) indicated that they do experience a reduction in the help needed when communicating, but only moderate reduction. Two participants (Participants 2 and 4) did not feel that there was any reduction at all in the help that they needed. This aspect of language and communication was therefore not regarded as totally positive and it is apparent that the LIPD adults still need support when communicating orally, especially in group activities.

The self-reported outcomes in terms of language in the work, school, or place of study setting, as well as in social situations, reveal that the cochlear implant could be having an important effect on the LIPD population and this must be considered when the success of the cochlear implant is evaluated. Communication skills are enhanced by a cochlear implant, even in LIPD adults who do not show improvement in speech recognition (Moody-Antonio et al., 2005). The LIPD adults' improvement in communication skills could lead to a cascade of effects, both in work and social settings. Due to improved communication skills, they may be able to function more effectively within the work setting with better performance and understanding. In the social setting, they may be more readily accepted into the hearing society. The audiologist could use the essence of these results to prepare families that their amount of involvement will not necessary diminish as the patient will still need help when communicating.

The open ended question at the end of Section C provided additional insight into the participants' self-reported perceptions regarding their language and communication skills. Since the use of the cochlear implant, the participants experienced this aspect as positive. One of the participants was very confident about her communication and language skills and said: *"Ek kan beter verstaan en beter kommunikeer. Mense kan nie glo dat ek doof is nie." (I am able to understand and communicate much better. People cannot believe that I am deaf).* This quote supports the results and indicates that the LIPD adults experience their communication and language skills as positive since they received the cochlear implant, even though objective tests do not necessarily concur. Furthermore, all of them reported that they now are able to understand more and can speak more. They all experienced that their communication skills improved, which is in agreement with the literature (Shramm et al., 2002; Moody-Antonio et al., 2005). It is important to take into consideration, however, that this study did not obtain pre- and postoperative data, and therefore it is not possible to objectively determine if the LIPD adults' language abilities have improved since the cochlear implant was received. The objectively assessed language data does indicate that this population's language abilities are not appropriate for their age, even after the cochlear implant was received.

4.5 Communication-related speech intelligibility outcomes – Description and discussion of results for sub-aim 3

The speech production skills and consequently the speech intelligibility of prelingually deaf individuals are generally poorer than those of postlingually deaf persons (Busby, Roberts, Tong & Clark, 1991). However, in the study by Zwolan, Kileny and Telian (1996), the participants reported that using the cochlear implant improved their expressive communication skills, including their speech intelligibility. Therefore, it is important to take both objectively assessed and self-reported outcomes of communication-related speech intelligibility into consideration when outcomes regarding this aspect are determined.

4.5.1 Objectively assessed communication-related speech intelligibility outcomes.

The literature suggests that prelingually deafened adolescents and adults are less likely to show improvements in speech production postimplantation than younger prelingually deafened children. Better speech intelligibility for patients with early onset of deafness is typically expected when implantation took place before 10 years of age (Dawson, Blamey, Dettman, Rowland, Barker, Tobey, Busby, Cowan & Clark, 1995). The results of speech intelligibility outcomes are summarized in Table 4.10 and visually represented in Figures 4.23, 4.24 and 4.25. The participants' production patterns of single speech sounds, sound combinations in the initial position in words and sound combinations in the final position in words, as well as their speech intelligibility ratings are presented.

Table 4.10: Summary of the objectively assessed speech intelligibility data (n=6)

Speech intelligibility results		Participant 1	Participant 2	Participant 3	Participant 5	Participant 6	Participant 7
1. Production of single speech sounds							
/p/:	**Initial**	√	√	√	√	√	√
	Medial	√	√	√	√	√	√
	Final	√	√	√	√	√	√
/b/:	**Initial**	√	√	√	√	√	√
	Medial	√	/m/	√	√	√	√
/m/:	**Initial**	√	/bm/	√	√	√	√
	Medial	√	/mb/	√	√	√	√
	Final	√	/p/	√	√	√ (nasal)	√
/f/:	**Initial**	√	√	√	√	√	√
	Medial	√	√	√	√	√	√
	Final	/p/	√	√	√	√	√
/v/:	**Initial**	√	√	√	/f/	√	√
	Medial	√	√	√	√	√	√
/t/:	**Initial**	√	√	√	√	√	√
	Medial	√	√	√	√	√	√
	Final	√	√	√	√	√	√
/d/:	**Initial**	√	√	√	√	√	√
	Medial	√	√	√	√	√	√
/n/:	**Initial**	√	√	√	√	√	√
	Medial	√	√	√	√	√	√
	Final	√	√	√	√	√	√
/l/:	**Initial**	/j/	/t/	√	√	√	√
	Medial	√	√	√	√	/h/	√
	Final	-	√	√	√	√	√
/r/:	**Initial**	√	√	√	√	√	√
	Medial	√	√	√	√	√	√
	Final	√	/rx/	√	√	/rx/	√
/s/:	**Initial**	√	Distortion	√	√	/sh/	/sh/
	Medial	/sh/	Distortion	√	√	√	/sh/
	Final	√	Distortion	√	√	√	/sh/
/k/:	**Initial**	-	√	√	√	√	√
	Medial	-	/h/	√	/t/	√	√
	Final	√	√	√	No plosive	√	√
/x/:	**Initial**	√	/kx/	√	√	/h/	√
	Medial	√	√	√	√	/hj/	√
	Final	-	√	√	√	/h/	-
/ŋ/:	**Medial**	/h/	√	√	√	/h/	√
	Final	√	/x/	√	/n/	√	√
/h/:	**Initial**	-	√	√	√	√	√
/j/:	**Initial**	-	/kj/	√	/zj/	√	√
/g/:	**Initial**	/h/	√	√	/x/	/x/	√
/sh/:	**Initial**	√	/h/	√	/s/	√	√
	Medial	/s/	/t/	/s/	/s/	√	√
/z/:	**Initial**	√	/t/	√	/s/	√	√

2. Production of sound combinations in initial word position						
/pl-/	/p/	√	√	√	√	√
/bl-/	/b/	√	√	/bəl/	√	√
/fl-/	/f/	√	√	√	/f/	√
/sl-/	/s/	/t/	√	√	/s/	√
/kl-/	/l/	√	√	√	√	√
/xl-/	/hl/	√	√	√	/hl/	√
/pr-/	/pər/	√	√	√	√	√
/br-/	√	/bj/	√	√	√	√
/tr-/	√	√	√	√	√	√
/dr-/	/d/	√	√	√	√	√
/kr-/	/kj/	√	√	√	√	√
/xr-/	/hr/	√	√	√	/xhər/	√
/sw-/	/w/	/m/	√	√	√	√
/kw-/	/w/	√	√	√	√	√
/kn-/	/t/	/kr/	√	/kən/	√	√
/sp-/	√	/p/	√	√	√	√
/st-/	/t/	/t/	√	√	√	√
/sk-/	/s/	/k/	√	/st/	/k/	√
/spr-/	/pr/	/pr/	√	√	√	√
/str-/	/tr/	/tr/	√	√	/sk/	√
/skr-/	/tr/	/tr/	√	√	√	√
3. Production of sound combinations in final word position						
/-lp/	√	√	√	√	√	√
/-lf/	√	√	√	√	√	√
/-lt/	/hd/	√	√	No plosive	√	√
/-ls/	√	√	√	√	√	/s/
/-lk/	/t/	√	√	/lt/	√	√
/-rt/	/hd/	/jd/	/hd/	/hd/	√	√
/-rs/	√	/s/	√	/r/	/hs/	√
/-rk/	/rx/	/r/	/r/	√	√	√
/-rx/	√	/r/	√	√	/rjx/	√
/-ŋk/	-	/k/	√	√	/k/	√
/-nt/	√	√	√	√	√	√
/-ts/	/s/	/s/	√	√	/təs/	/s/
/-ks/	/həs/	/kəs/	√	√	/kəs/	√
/-ŋc/	/nt/	/t/	/t/	√	/nəc/	√
4. Speech Intelligibility Rating (SIR)						
Category	3	3	5	4	3	4

Key: * √ = correct production of the speech sound

* /_/ = substituted sound

* - = sound is omitted

The individual speech characteristics relating to the production of speech sounds and speech intelligibility are discussed below.

- **Participant 1**

Participant 1's production of single speech sounds was mostly correct. It was observed that she experienced problems with the production of the /f/ in the final position in words, the /l/ in initial and final position in words and the /s/ in middle position in words. The /ŋ/ sound in the medial position was produced as a /h/ sound and the /sh/ sound was produced as a /s/ in the final position. She omitted the /h/ and /j/ in words. She experienced problems with the production of most of the initial and final sound combinations. Her speech intelligibility was classified as poor, but an experienced listener is able to follow her utterances with the help of contextual cues and speech reading.

- **Participant 2**

Participant 2 exhibited more speech production errors. She experienced problems with consonants produced in the front, middle and back position of the mouth. The /s/ sound was produced with distortion in all positions in words. She also produced most sound combinations incorrectly and the combinations were usually characterised by substitution of the correct sounds with another sound. Her speech intelligibility was also classified as poor, but an experienced listener will be able to follow her speech with additional help.

- **Participant 3**

Participant 3 presented with the best speech production in both single speech sounds and in speech sound combinations. Consequently, her speech intelligibility was classified as good. This participant acquired her hearing loss the latest of all the participants and had used her cochlear implant longer than most of the other participants. The shorter duration of deafness and longer duration of implantation may be related to better articulation and speech intelligibility skills.

- **Participant 5**

Participant 5's speech intelligibility was classified as good, but the listener still needs to concentrate and speech-read what is said. His production of speech sounds reflects his speech intelligibility. He produced the following single sounds incorrectly: -the /v/ sound without voice in the initial position in words; -the velar /k/

sound was substituted with a /t/ sound in the medial position in words and was produced without voice in the final word position; - the /ŋ/ sound was simplified to a /n/ in the final position in words; -the /sh/ and /z/ sounds were simplified to a /s/ in all positions; -the /g/ sounds was produced as a /x/ sound; and the /j/ sounds was produced with an additional /z/ sound. Errors in the production of sound combinations also occurred and consisted mostly of addition of sounds and the substitution of the correct sound with another sound.

- **Participant 6**

Participant 6's general speech intelligibility was regarded as poor and she presented with many speech errors. She presented with speech characteristics such as hypernasality and the substitution and addition of sounds when producing the single sounds, as well as the sound combinations. It was observed that she could not produce the unvoiced, velar /x/ sound at all.

- **Participant 7**

Participant 7 presented with the second best speech intelligibility and production of speech sounds. He experienced problems with the production of the /s/ sound in all positions in words. It was observed that he also omitted sounds in sound combinations, especially the combinations that contained the /s/. His speech intelligibility was regarded as good, but it was necessary to concentrate and speech-read what was said.

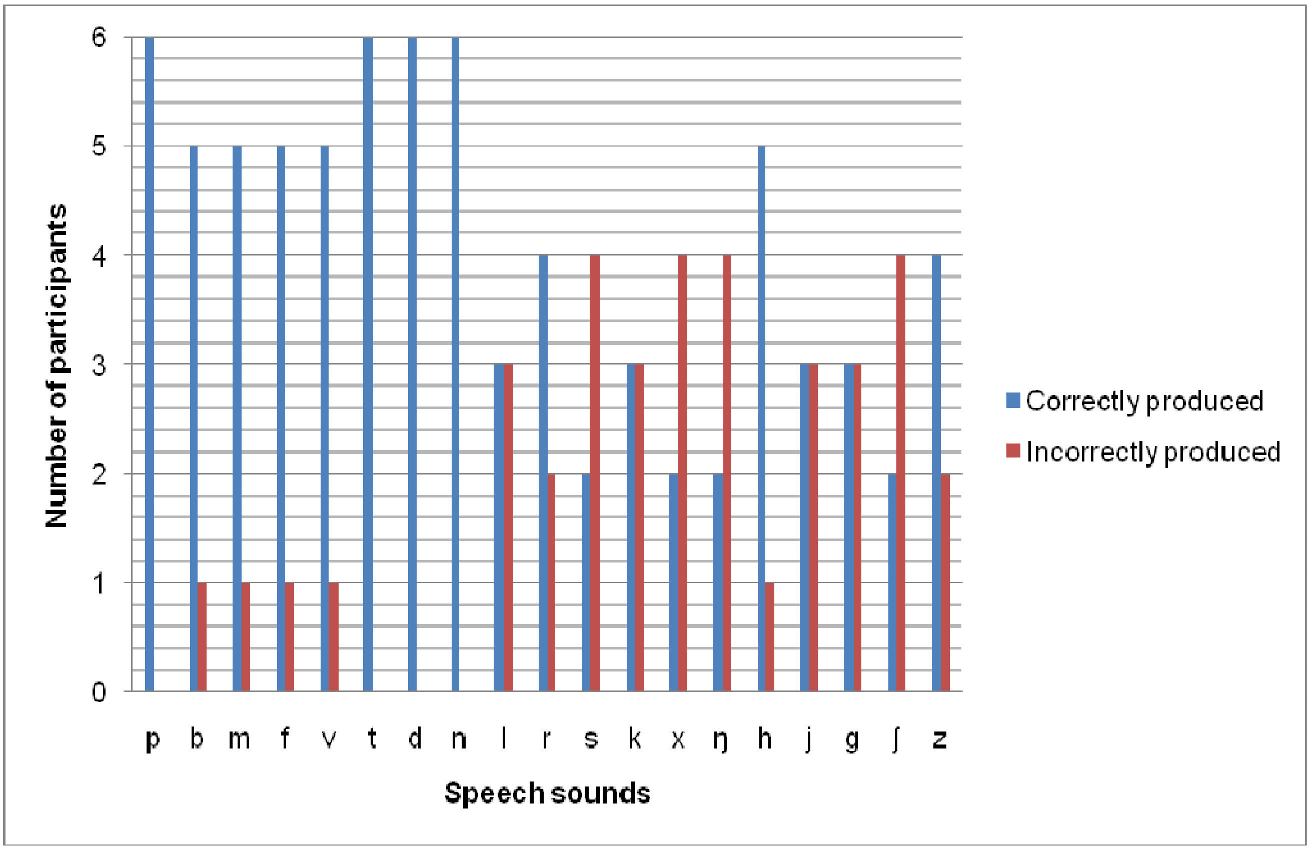


Figure 4.24: Production pattern of single speech sounds (n=6)

A closer examination of the consonant productions in the articulation test revealed that consonants articulated at the front of the mouth were more accurately produced. All the participants were able to articulate the /p/ consonant correctly and five of the participants correctly produced the /b/, /m/, /f/ and /v/ consonants. Consonants produced in the front of the mouth are generally more accurate because they are more visible, the lips are more restrained in movement than the tongue and fewer sounds are produced in the front than in the middle of the mouth (Dawson et al., 1995). The sounds produced in the middle of the mouth were therefore less consistently correct. All the participants were able to produce the /t/, /d/ and /n/ consonants correctly, but the lateral approximant /l/, trill /r/, alveolar fricatives /s/ and /z/ and the post alveolar /sh/ were produced with less success. The typical errors that occurred were the substitution of the sound with a simplified sound or the deletion of the sound in the targeted word. These errors are typical of prelingually deafened cochlear implant users and a study by Busby, Roberts, Tong and Clark (1991) found that consonant errors include deletions, substitutions by other consonants with different manner or place of articulation, and errors in voicing. Consonants in the less visible velar and palatal positions are typically not as accurately produced either (Dawson et al., 1995). Five participants in the current study (Participants 2, 3, 5, 6 and 7) were able to produce the glottal approximant /h/ correctly, but the other back sounds were produced with varying degress of accuracy. The velar plosives /k/ and /g/, as well as the palatal approximant /j/ were correctly produced by three participants and were either substituted or deleted by the other three participants. The velar nasal /ŋ/ and the velar fricative /x/ were correctly produced by only two participants. The other four participants mostly substituted the sounds and one participant omitted the sound in the target words. In summary, it was found that consonants produced at the front of the mouth were more accurate than those produced further back in the mouth. This finding is supported by the literature (Dawson et al., 1995).

Figures 4.25 and 4.26 display the production of consonant blends in respectively initial and final position in words, as was summarized in Table 4.10.

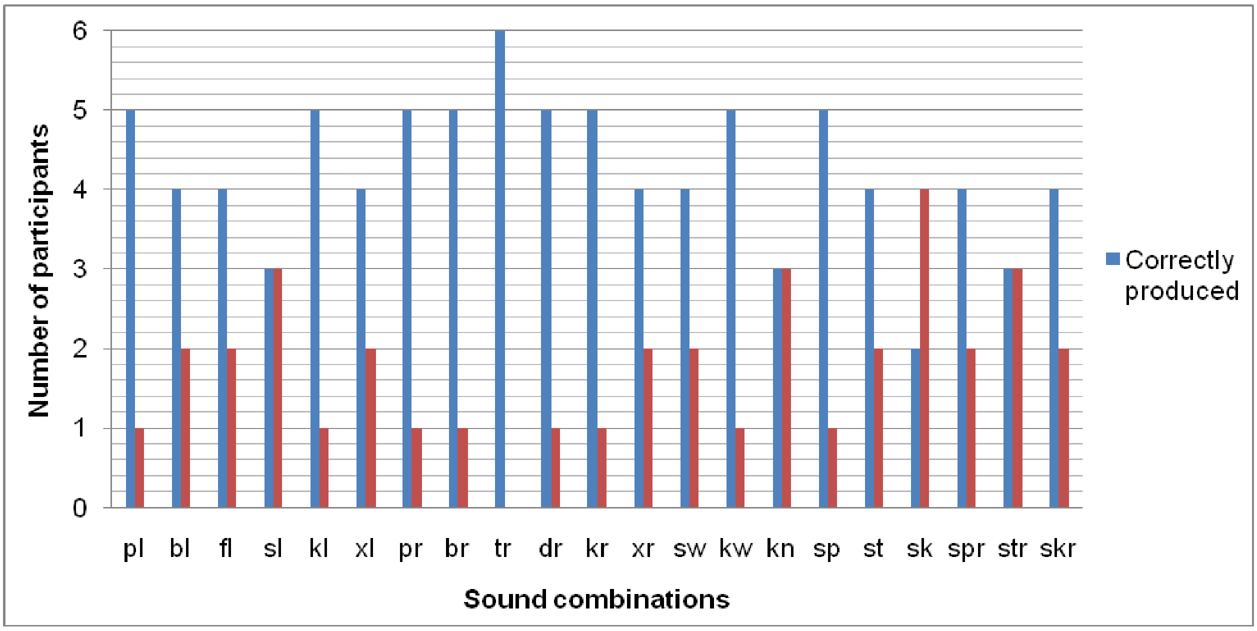


Figure 4.25: Production patterns of sound combinations in initial position in words (n=6)

The production of sound combinations in the final position in words is presented as follows.

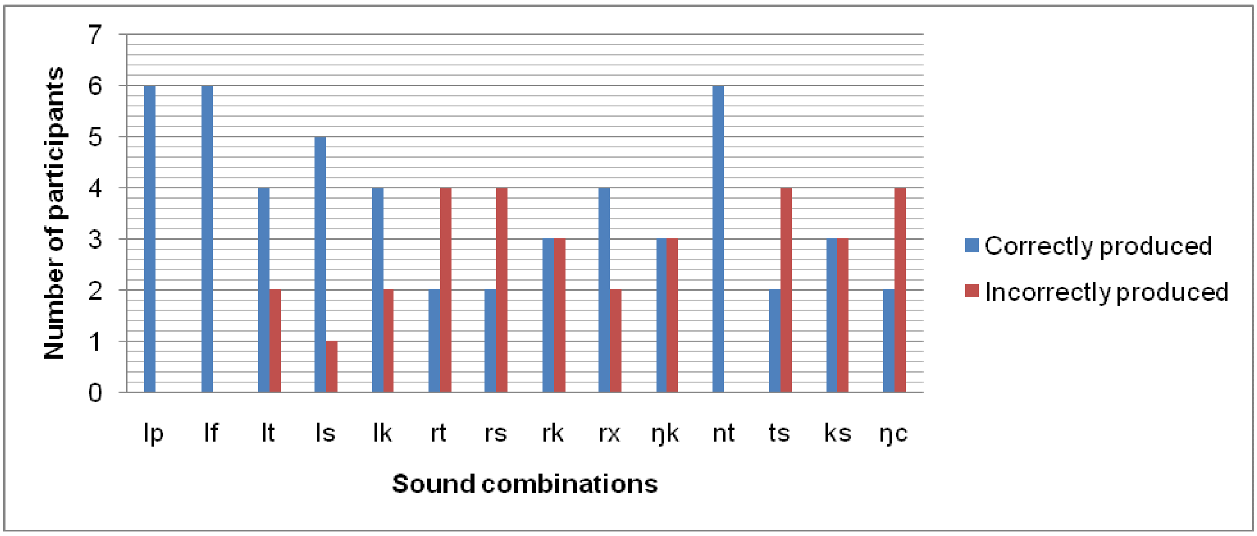


Figure 4.26: Production pattern of sound combinations in the final position in words (n=6)

The results of the production of consonant blends were different for every participant. It was found that the following consonants were correctly produced by all the participants: /tr-/, /-lp/, /-lf/ and /-nt/. It is obvious that all these blends contain at least one consonant that was correctly produced by all the participants as a single speech sound. The following blends were correctly produced by five of the participants: /pl-/, kl-/, /pr-/, /br-/, /dr-/, /kr-/, /kw-/, /sp-/ and /-ls/. The typical errors produced by the other participant were substitution of one of the sounds, the deletion of one of the consonants in the blend, or the addition of a schwa-vowel /ə/. Four of the participants were able to produce the following blends correctly: /bl-/, /fl-/, /xl-/, /xr-/, /sw-/, /st-/, /spr-/, /-lt/, /-lk/ and /-rx/. The consonant blends /sl-/, /kn-/, /str-/, /-rk/ and /-ks/ were correctly produced by three of the participants. The consonant blends produced incorrectly by most of the participants were the following: /sk-/, /-rt/, /-rs/, /-ts/ and /-ŋc/.

The *Speech Intelligibility Rating* scale scores achieved by every participant are listed in Figure 4.27.

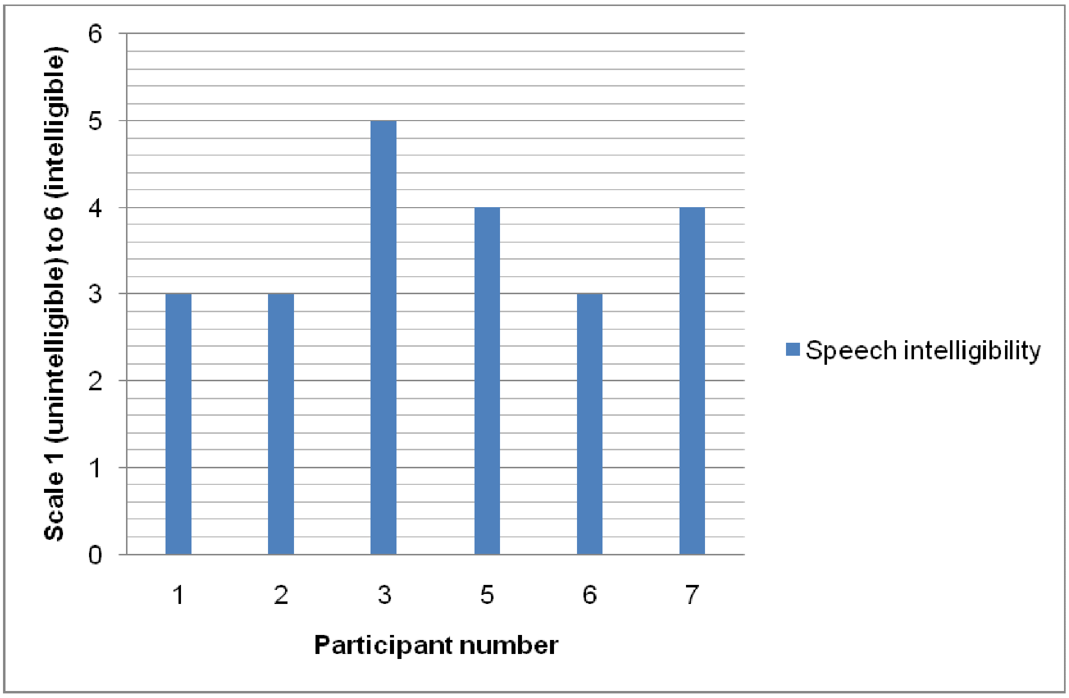


Figure 4.27: Speech intelligibility rating (SIR) (n=6).

Participants 1, 2 and 6 scored a three, which indicates that their speech is unintelligible, but experienced listeners can follow a known topic with the help of speech-reading and contextual cues. The parents of Participants 1 and 2 were present during the interview schedule and assessment, and they often helped the researcher by explaining the participant's utterances if the researcher found them unintelligible. Participants 5 and 7 scored a four, which indicates that speech is intelligible to a listener who concentrates and speech-reads. Participant 3 scored a five, which indicates that speech is intelligible to listeners with little experience of the speech of a deaf speaker. Cochlear implantation appears to influence speech intelligibility positively, especially in children, but there are lower expectations for improvement in speech production and intelligibility in older hearing-impaired participants with early onset of deafness (Dawson et al., 1995).

Participant 3 presented with the best articulation and speech intelligibility skills. This participant acquired her hearing loss the latest of all the participants and had her cochlear implant the second longest. The shorter duration of deafness and duration of implantation may be related to with better articulation and speech intelligibility skills.

4.5.2 Self-reported communication-related speech intelligibility outcomes

The results regarding the self-reported communication-related speech intelligibility outcomes were obtained in Section D of the interview. The speech intelligibility outcomes examined the self-reported speech characteristics, the participants' ability to control their own voices, and how they perceived other people's experiences regarding the pronunciation of their words and their general speech intelligibility. Participant 4 did not give feedback regarding her speech intelligibility, because she does not make use of spoken communication. A summary of all the self-reported speech intelligibility results are presented in Table 4.11.

Table 4.11 Summary of all the self-reported speech intelligibility data (n=6).

Self-reported speech intelligibility results	Participant 1	Participant 2	Participant 3	Participant 5	Participant 6	Participant 7
Speech characteristics: - Before implantation	Too slow	Too loud	Too loud	Too loud	Too loud	Too slow & too loud
- After implantation	More controlled	More controlled	Too loud and too fast	More controlled	More controlled	More controlled
Control of own voice	Moderately able to control voice	Can control voice very easily	Moderately able to control voice	Can control voice very easily	Can control voice very easily	Can control voice very easily
Other people's experience regarding pronunciation of words	Much improved	Improved	Improved	Improved	Improved	Improved
Other people's experience regarding general speech intelligibility	More intelligible	More intelligible	More intelligible	More intelligible	More intelligible	More intelligible

Improvements in the range of the fundamental frequency, stress patterns, and intonation contours have been recorded with LIPD adult cochlear implant users (Busby et al., 1991). These results of this study reflect the objectively determined results obtained by Busby et al. (1991). Four of the participants (Participants 2, 3, 5 and 6) indicated that their speech could be characterized as too loud before implantation, whereas Participant 1 experienced her speech as too slow before implantation. Participant 7 indicated that his speech was too slow and too loud before the implantation. According to Dawson et al., it was estimated that unfamiliar listeners are only able to understand one in five words of the speech of profoundly hearing-impaired speakers. Speech characteristics such as speaking too slow and too loud could contribute to their poor speech intelligibility.

Five of the participants (Participants 1, 2, 5, 6 and 7) indicated that their speech is more controlled in terms of volume and speed after the implantation. This can be regarded as a positive outcome in speech intelligibility experienced by LIPD adults. Participant 3 has not experienced her speech intelligibility after implantation as positive, and indicated that she experienced her speech as too loud and too fast. Busby et al. (1991) found that improvement in speech production may have been due to the use of tactile-kinesthetic feedback, for example airflow through the nose for nasals and tongue position and airflow for alveolar consonants. The self-reported positive experiences regarding their more controlled speech could therefore be due to better auditory-kinesthetic feedback.

There are lower expectations for improvement in speech production and speech intelligibility for older hearing-impaired persons with early onset of deafness. Dawson et al. (1995) found it encouraging to see a significant increase in speech intelligibility post-implantation. Figure 4.28 depicts how the participants experienced their ability to control the sound of their voices since receiving the cochlear implant.

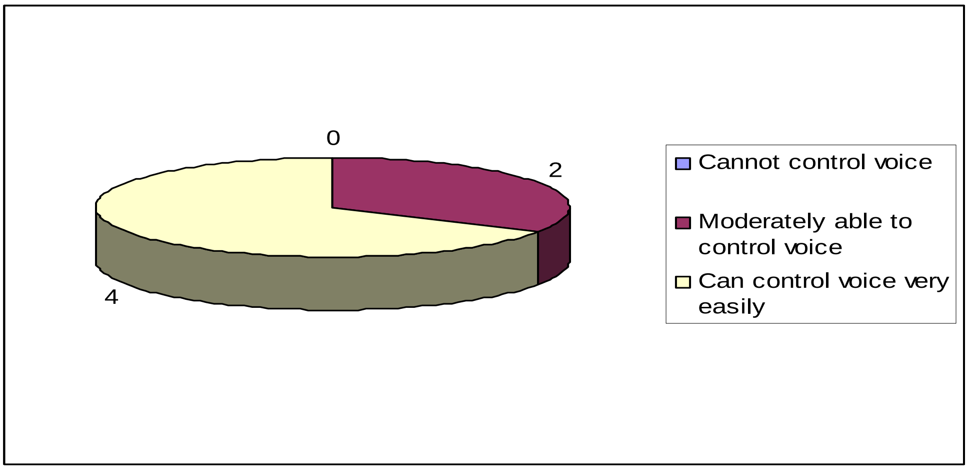


Figure 4.28: Ability to control the sound of their voices (n=6)

Four of the participants (Participants 2, 5, 6 and 7) indicated that they are able to control the sound of their voices more easily since the cochlear implant and the other two participants (Participants 1 and 3) experienced that they are moderately able to control the sound of their voices since the use of the cochlear implant. The results can therefore be regarded as a self-reported positive outcome in terms of speech intelligibility.

Restoration of hearing, however limited, via cochlear implantation appears to positively influence speech intelligibility. Figures 4.29 and 4.30 present the results of how the participants perceive other people's experience of their pronunciation of words and overall speech intelligibility.

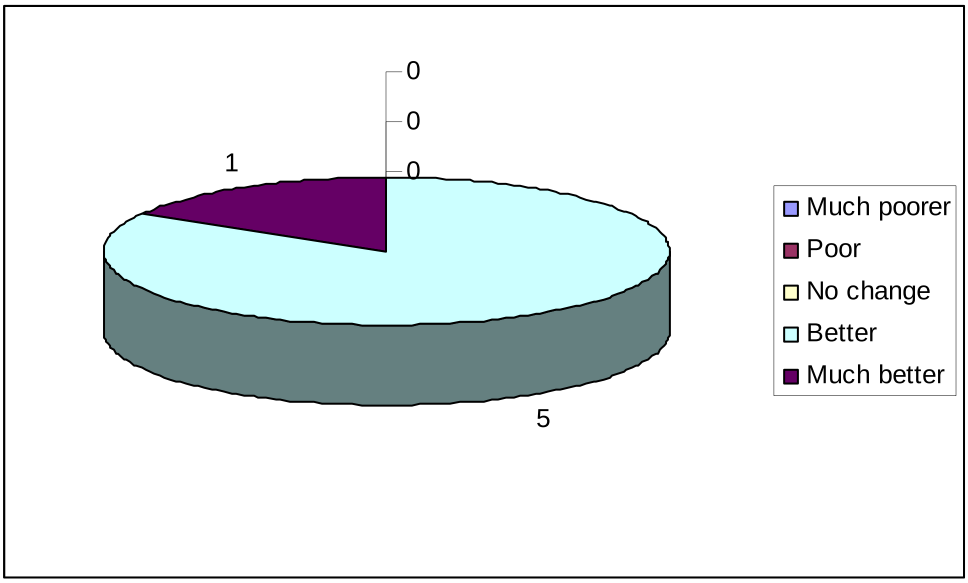


Figure 4.29: Perceptions of participants regarding other people's experiences regarding their pronunciation of words since the use of the cochlear implant (n=6).

Five of the participants (Participants 2, 3, 5, 6 and 7) indicated that they feel others perceive their pronunciation of words to be better since the participants made use of the cochlear implant. Participant 1 indicated that her pronunciation of words is much better than before the implantation. According to Dawson et al. (1995), the LIPD adults presented with significant gains in accuracy of production of speech sounds, and consequently word intelligibility will also increase and will be interpreted as better pronunciation of word to non-experienced listeners.

Figure 4.30 depicts the participants' views on how other people perceive their overall speech intelligibility since the use of the cochlear implant.

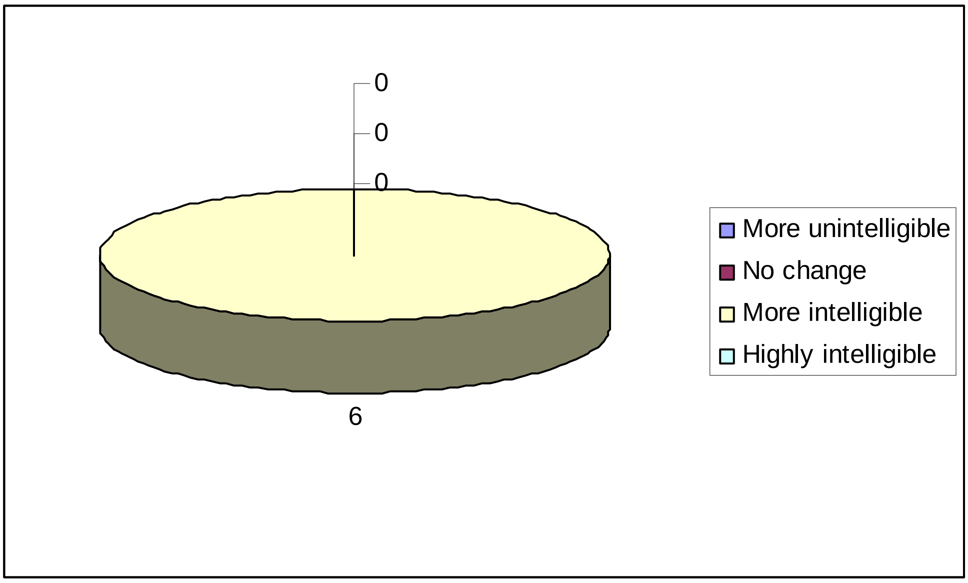


Figure 4.30: Participants' views on how other people experiences their overall speech intelligibility (n=6).

All the participants indicated that they think other people experience their overall speech intelligibility as more intelligible since the use of the cochlear implant. Postoperative speech intelligibility was found by Dawson et al. (1995) to be significantly higher than pre-operative intelligibility. A possible explanation is that listeners may use contextual information more effectively when intelligibility is higher (Dawson et al, 1995).

Responses to the open-ended question at the end of Section D revealed that the participants experience their speech intelligibility since the use of the cochlear implant as positive. They have mostly emphasized again that they are able to control their voices better and are now able to hear their own voices. In general they feel that their speech has improved since the use of the cochlear implant. The following quote from one of the participants supports the self-reported findings: *"… en as ek dit uitspreek kan ek dit beter beheer." (… and when I pronounce it I am able to control it better).*

It is apparent that the LIPD adults experience their speech intelligibility as positive since the use of the cochlear implant, and the implication is that cochlear implantation could be considered as meaningful in this population. Improvement in speech production is an important benefit of implantation (Steller, Beiter & Brimacombe, 1991). In most working and social situations, verbal communication is used and in order to be fully integrated in these situations, the LIPD adults need to display a certain degree of speech intelligibility. Their self-reported speech intelligibility outcomes indicate that improvements in these areas may contribute to better functioning within working and social situations.

The audiologist involved in the cochlear implant team must also consider these results when informing prelingually deafened adult candidates regarding the speech intelligibility outcomes. Both the negative objectively assessed and positive self-reported outcomes should be discussed during the decision-making process. The audiologist should also encourage the LIPD adult cochlear implant users to attend speech therapy training in order to optimize intelligibility.

4.6 Communication-related quality of life outcomes – Description and discussion of results for sub-aim 4.

Quality of life is defined as an individual's perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards and concerns (WHO Quality of Life Group, 1993). It is a broad-ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, and their relationships to salient features of their environment (WHO Quality of Life Group, 1993). Cochlear implants provide deaf and profoundly hearing-impaired persons with an improved ability to participate more actively in a society where sound is the most important factor for communication (Mo, Lindbaek & Harris, 2005). It is important, therefore, to determine the communication-related quality of life outcomes of the LIPD adults to ensure that a holistic and functionalistic view of this population is obtained.

4.6.1 Self-reported communication-related quality of life outcomes.

Section E of the interview was used to obtain the results regarding the self-reported communication-related quality of life outcomes and these results are summarized in Table 4.12. The outcomes will be discussed under the subheadings Quality of Life in everyday situations, Quality of Life at work / school / place of study and Quality of Life in social situations.

Table 4.12 Summary of all the self-reported communication-related quality of life data (n=7)

Self-reported quality of life results	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7
1. Quality of life in everyday situations:							
Influence of CI on daily life	No change	Much easier	Slightly easier	Much easier	Slightly easier	Slightly easier	Slightly easier
Change in independency	More independent	More independent	More independent	No change	More independent	More independent	More independent
Change in relationship with family members	Improved	Improved	No change	Improved	No change	Improved	Improved

Impact of CI on relationship with partner	Not applicable	Improved	No change	Not applicable	Improved	No change	Improved
Impact of CI on relationship with friends							
- **Deaf friends**	Improved	Deteriorated	No change	Not applicable	Improved	No change	No change
- **Hearing friends**	Improved	Improved	No change	Not applicable	Improved	Improved	Improved
2. Quality of life at work/ school/ place of study:							
Qualify of relationship with co-workers, teachers or lecturers since the use of the CI	More satisfying	More satisfying	Same as before	Not applicable	More satisfying	Same as before	Same as before
Satisfaction with employment or studies since the use of the CI	More satisfying	More satisfying	Same as before	Not applicable	Less satisfying	More satisfying	More satisfying
Effect of CI on work performance	Positive	No effect	No effect	Not applicable	Positive	Positive	Positive
3. Quality of life in social situations:							
Experiences in social situations when CI is used:							
- **Less isolated**	No	Yes	No	Yes	Yes	Yes	Yes
- **No avoidance of social contact**	Yes	Yes	No	Yes	Yes	Yes	Yes
- **Less embarrassed**	Yes	No change	No	Yes	Yes	Yes	Yes
Change in amount of social activities since CI is used	Greatly increased	Greatly increased	Slightly decreased	Not applicable	Greatly increased	Greatly increased	Slightly increased
Experience regarding how comfortable participants are in social events	Very comfortable	Very comfortable	Moderately comfortable	Not applicable	Moderately comfortable	Very comfortable	Very comfortable
Change in self-confidence since the CI is used	A great increase	A great increase	Moderate increase	Moderate increase	A great increase	A great increase	Moderate increase
Change in self-consciousness since the CI is used	No change	Less self-conscious	More self-conscious	Less self-conscious	Less self-conscious	Less self-conscious	Less self-conscious

"Deaf friends" in Table 4.12 refer to the LIPD adults' friends that are also profoundly deaf and make use mostly of Sign Language for communication

4.6.1.1 Quality of Life in everyday situations

Quality of Life in everyday situations first examined the extent to which the cochlear implant has influenced the LIPD adults' daily life. Figure 4.31 depicts the extent to which the participants' daily life has become easier and less effortful since the use of the cochlear implant.

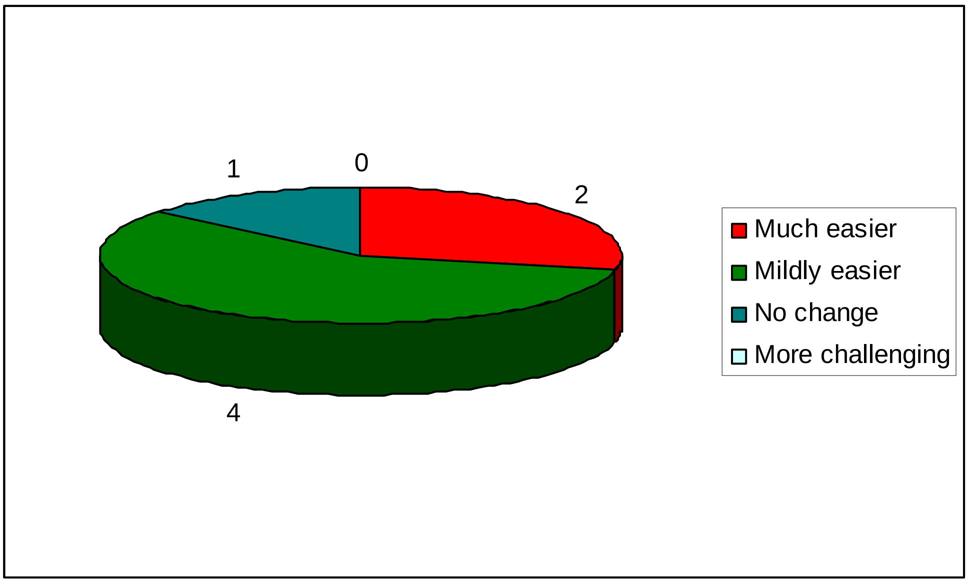


Figure 4.31: The extent to which the participants' daily life has become easier and more effortless since the use of the cochlear implant (n=7).

An economic and cost-effective outcome of cochlear implantation for adults, as determined by Sanderson and Nash (2001), is better performance of daily activities. The LIPD adults indicated in general that the cochlear implant has a positive effect on their daily life. Four of the participants (Participants 3, 5, 6 and 7) indicated that the cochlear implant makes their daily life, which includes daily routine, daily activities and daily chores, mildly easier and two participants (Participants 2 and 3) felt that the cochlear implant makes their daily life much easier. Only Participant 1 indicated that the cochlear implant did not change her daily life. It can therefore be concluded that the cochlear implant has a positive effect on this population's daily life.

The LIPD adult's independence since the cochlear implant has been used, was examined next. Figure 4.32 represents the self-reported independence outcomes as stated by the participants.

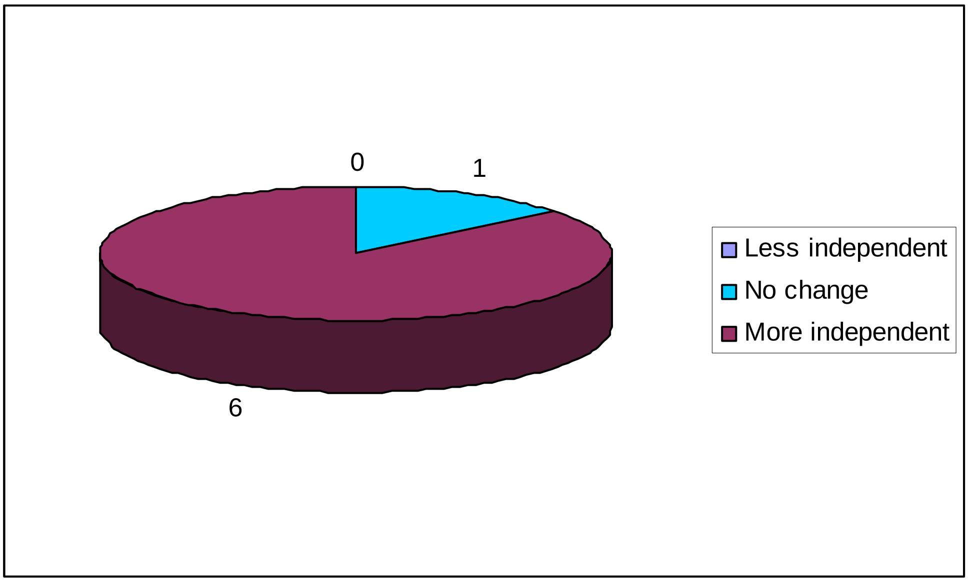


Figure 4.32: The participants' independence since the use of the cochlear implant (n=7).

Six of the participants (Participants 1, 2, 3, 5, 6 and 7) stated that the use of the cochlear implant made them more independent. Participant 4, who presented with multiple disabilities and who is taken care of by her mother, indicated that the there was no change in her independence since the use of the cochlear implant. It is obvious, however, that her independence will also be influenced by her visual problems. For the other participants, the cochlear implant contributes to more independence. These results correlate with other research done in terms of LIPD adults (Zwolan, Kileny & Telian, 1995; Moody-Antonio et al., 2005).

People close to a deaf or profoundly hearing-impaired person must learn to cope with a range of issues in their daily lives because of the communication difficulties related to deafness (Mo, Lindbæk & Harris, 2005). The next four questions were related to the impact the cochlear implant has on relationships with significant others. Figure 4.33 represents the change in the participants' relationships with their family members.

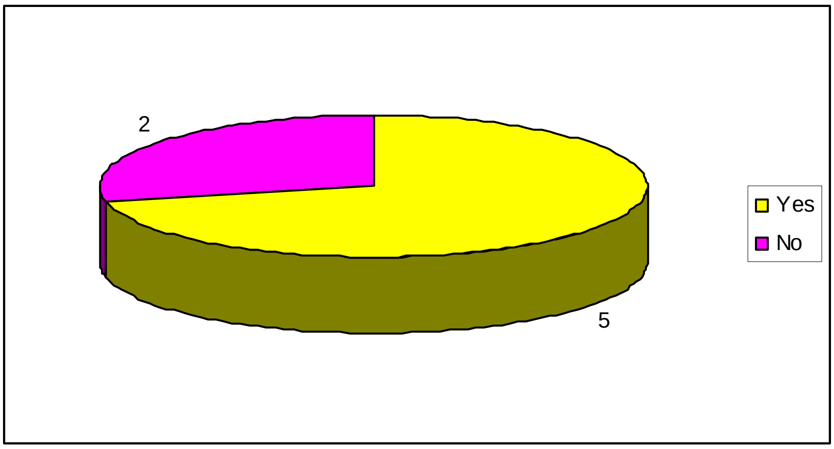


Figure 4.33: The participants' indication if their relationships with their family members have changed (n=7).

The participants were asked if their relationships with their family members have changed and if the answer was yes, they were asked to elaborate. Five of the participants indicated that their relationships with their family members have changed. Participant 1, 2 and 6 said that their relationships have improved since the use of the cochlear implant. Participant 4 indicated that she is not isolated any more and this has consequently improved her relationships with her family members. Participant 7 has also indicated that his relationships have improved and he is now able to communicate with them more successfully. Figure 4.34 investigated the impact of the cochlear implant on their relationship with their partners, who could be a spouse, partner, boyfriend or girlfriend.

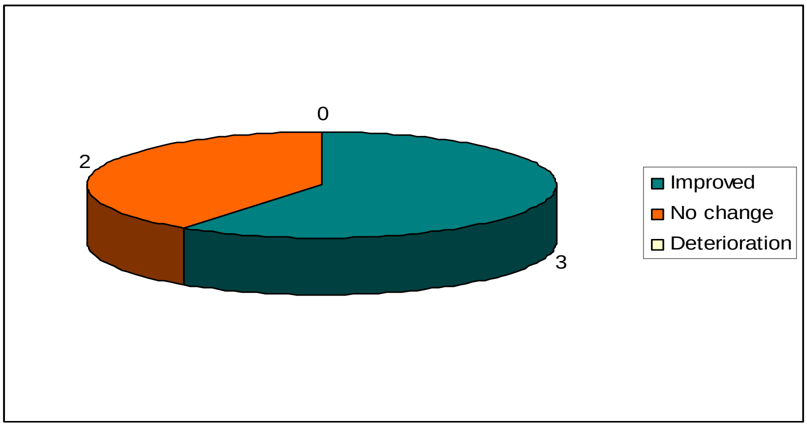


Figure 4.34: The impact of the cochlear implant on the participants' relationship with their partners (n=5).

Three participants (Participants 2, 5 and 7) indicated that their relationships with their partners have improved. They indicated that the cochlear implant has a positive effect on this type of relationship and they are now able to communicate better with their partner. Two participants (Participants 3 and 6) indicated that this relationship has stayed the same and no change was observed. Participant 1 and 4 indicated that the question was irrelevant to their lives and did not provide any answer to this question.

Mo, Lindbæk and Harris (2005) found that cochlear implant users experienced improved relationships with their family. The results of this study show that this is also the case with LIPD adults.

Figures 4.35 presents the participants' self-reported experiences regarding the quality of their friendships. Friendships with respectively deaf friends and hearing friends were investigated. Participant 4 did not provide any answers to these two questions because she spends all her time with her mother and not with friends.

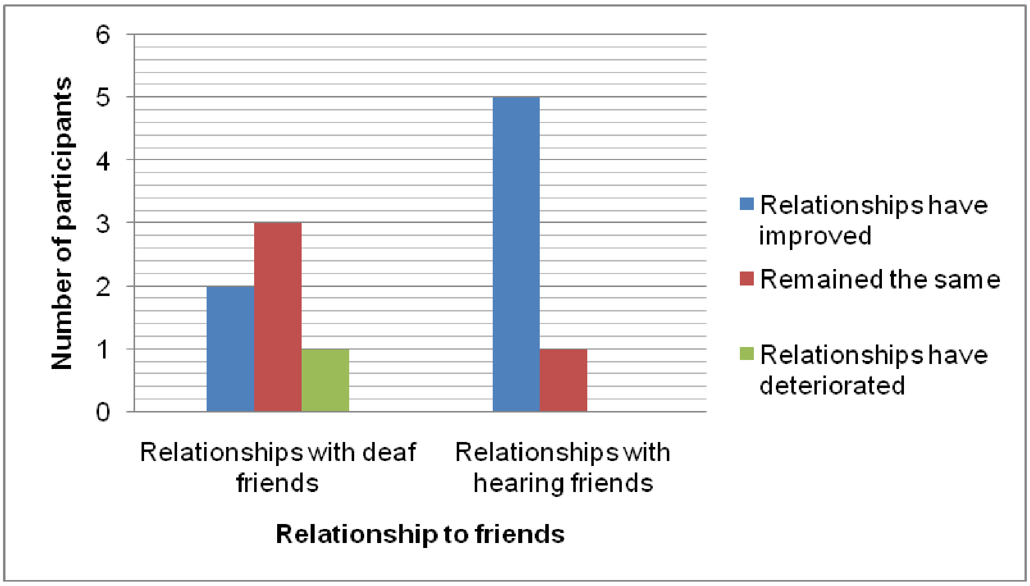


Figure 4.35: The impact of the cochlear implant on the participants' quality of their relationships with their friends (n=6).

Three of the participants (Participants 3, 6 and 7) indicated that their relationships with their deaf friends have stayed the same since the use of the cochlear implant and two (Participants 1 and 5) indicated that their friendships have improved. Only Participant 2 felt that her relationship with her deaf friends has deteriorated. Many members of the deaf community, the majority of whom are prelingually deafened, oppose cochlear implants (Zwolan, Kileny & Telian, 1996), and this may possibly contribute to the deterioration in the quality of her friendships with her deaf friends.

Five participants (Participants 1, 2, 5, 6 and 7) revealed that the quality of their friendships with their hearing friends improved and Participant 3 indicated that her friendships stayed the same. In general, the LIPD adults felt that the quality of their friendships improved and these results correlated with results from the quality of life study by Mo, Lindbæk and Harris (2005), which also found that cochlear implant users experienced improved relations with their friends.

The self-reported positive outcomes regarding quality of life in everyday situations could indicate that cochlear implantation has a meaningful effect on the LIPD adults. According to Sanderson and Nash (2001), a cochlear implant contributes to the restoration of certain quality of life attributes and therefore cochlear implant users have the best possible chance to reach their potential in the hearing world. Being more independent and having better relationships with their family and friends could definitely lead to better integration into the hearing world and society. It is therefore evident that a cochlear implant also provides LIPD adults with improvement in the ability to participate more actively in society (Mo, Lindbæk & Harris, 2005). The audiologist could use this information regarding the quality of life outcomes in everyday situations to counsel prelingually deafened adults regarding the improvement in quality of life.

4.6.1.2 Quality of Life at work/ school/ place of study

The “Quality of life at work, school, or place of study” sub-section examined the participants’ relationships with their co-workers, teachers or lecturers, as well as their self-reported employment / studies satisfaction and work performance. A significant majority of cochlear implant recipients have recorded increased job satisfaction and feelings of success as a result of their improved communication abilities. Other benefits such as increased activities and duties, enhanced training opportunities, improved employer-employee relationships and enhanced pay were also noted (Sanderson & Nash, 2001). It is therefore important to determine if the LIPD adults in the current study also experienced these outcomes with the use of the cochlear implant. Figure 4.36 visually represents the participants' self-reported quality of their relationships with their co-workers, teachers, or lecturers. Participant 4 does not work and did not provide answers to the questions regarding the quality of life at work, school, or place of study.

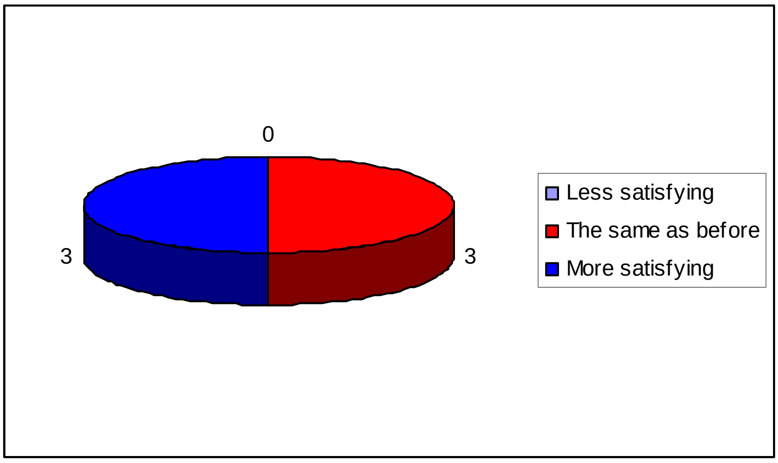


Figure 4.36: The quality of relationships with co-workers, teachers or lecturers since the use of the cochlear implant (n=6).

More satisfying work relationships were indicated by three participants (Participants 1, 2 and 5). Three other participants (Participants 3, 6 and 7) felt that their relationships with work-related acquaintances stayed the same and did not change since the use of the cochlear implant. No negative statements regarding this aspect of work, school, or place of studies were made and it can therefore be concluded that improved or established work relationships in general can be regarded as a positive outcome of a cochlear implant. According to Mo, Lindbæk and Harris (2005), cochlear implant users reported that using a cochlear implant leads to improvement in interpersonal communication skills. The results of the current study reveal that this is also true for LIPD adult cochlear implant users.

Satisfaction with employment or studies was investigated as well and is represented in Figure 4.37.

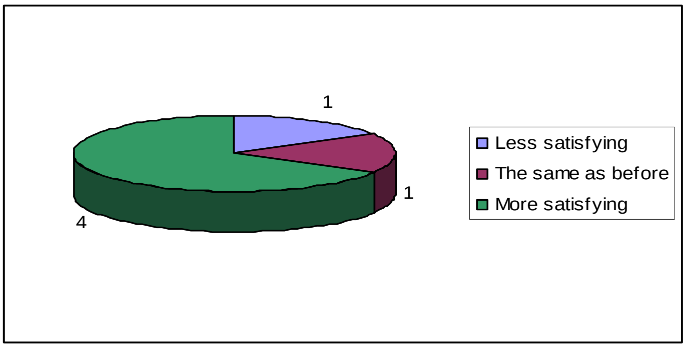


Figure 4.37: Satisfaction with employment or studies since the use of the cochlear implant (n=6).

Four participants (Participants 1, 2, 6 and 7) reported that they are more satisfied with their employment since the use of the cochlear implant, whereas Participant 3 indicated that satisfaction is the same as before. Participant 5, however, mentioned that he experienced his employment as less satisfying since the use of the cochlear implant, due to his awareness of environmental sounds that interferes with his concentration. In general, though, improved satisfaction in employment or studies can be regarded as positive in terms of cochlear implant use in the LIPD population. It can also be concluded that these participants complied with the expected quality of life work-related outcomes expected from postlingually deafened adults (Sanderson & Nash, 2001).

Work performance is also an important aspect to consider when quality of life at work, school, or place of studies is examined. Figure 4.38 presents the participants' self-reported experiences regarding their work performance.

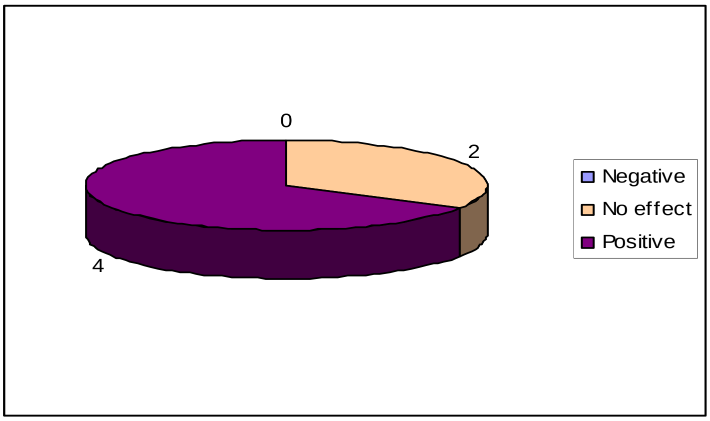


Figure 4.38: The effect of the cochlear implant on the participants' work performance (n=6).

The cochlear implant has a positive effect on four of the participants' work performance (Participants 1, 5, 6 and 7), whereas two participants (Participants 2 and 3) indicated that the cochlear implant has no effect on their work performance and that their work performance has stayed the same. It can be concluded that the majority of the LIPD cochlear implant users experiences the cochlear implant as positive in terms of work performance and it can therefore be regarded as a positive outcome of the cochlear implant. Zwolan, Kileny and Telian (1996) also indicated that this population experiences occupational progress, which correlates with the results of this study.

4.6.1.3 Quality of life in social situations

Although the primary objective of the cochlear implant is to facilitate oral communication, other quality of life attributes are often indirectly restored as a result of this medical intervention. This includes general self-esteem and social functioning (Sanderson & Nash, 2001). It was therefore important to determine if the LIPD adults experienced this kind of quality of life in social situations. The first question enquired about specific experiences regarding social situations since the use of the cochlear implant and the responses are represented in Figure 4.39.

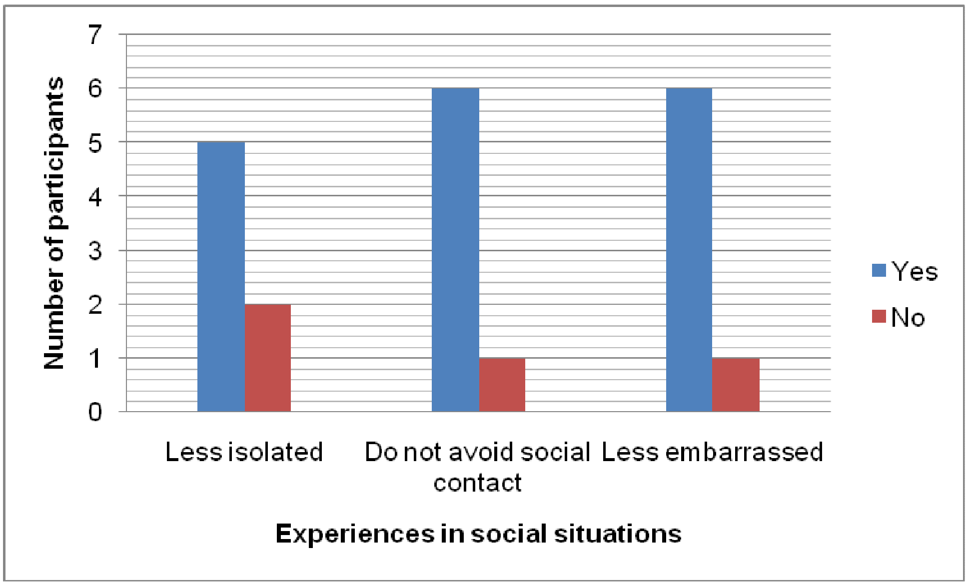


Figure 4.39: Specific experiences in social situations when the cochlear implant is used (n=7).

The improvement in quality of life also leads to less isolation, according to Mo, Lindbæk and Harris (2005). The responses from the LIPD adults also indicated that less isolation is experienced since the use of the cochlear implant. Two of the participants (Participants 1 and 3) did not feel less isolated since using the implant. The majority of the participants (Participants 2, 4, 5, 6 and 7), however, reported that they feel less isolated and it can therefore be regarded as a positive aspect of implantation in this population. Zwolan, Kileny and Telian (1996) also indicated that the LIPD population feel less lonely as a result of their getting an implant and his finding supports the findings of the current study.

Six of the participants (Participants 1, 2, 4, 5, 6 and 7) indicated that they do not avoid social contact any more, and feel less embarrassed since using the cochlear implant. Participant 3 did not feel that this is the case with her cochlear implant, but could not provide a reason for this experience. In general, however, these LIPD adults described social connectedness as a positive outcome of the implantation (Mo, Lindbæk & Harris, 2005).

Cochlear implant users feel that they are less of a burden in their social environment than before using an implant (Mo, Lindbæk & Harris, 2005). Question E10.1 and

E10.2 enquired about the LIPD adults' experiences regarding their social activities. Figure 4.40 and 4.41 visually represent their self-reported experiences regarding this aspect. Participant 4 does not attend social activities due to her multiple disabilities and therefore did not provide any answers to the two questions. The presence of Participant 4's multiple disabilities, which include blindness and physical disabilities, prevents her from forming friendships and negatively influences her social activities. It can therefore be concluded that the lack of these relationships and activities are not because of her deafness alone, but mainly because of all her multiple disabilities.

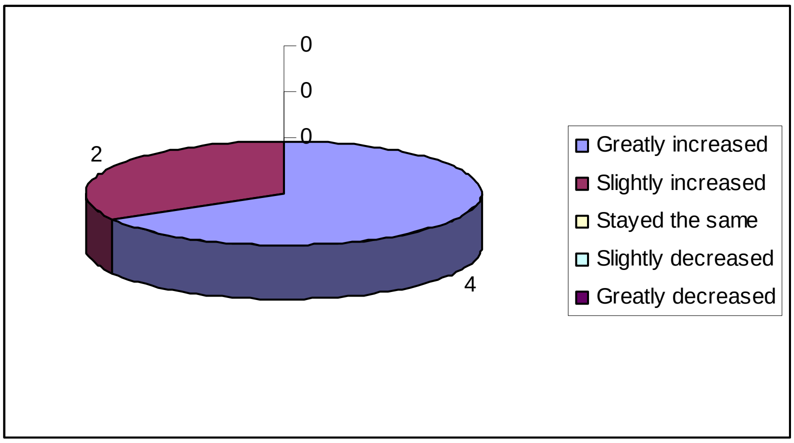


Figure 4.40: The change in the amount of social activities the participants attend since the use of the cochlear implant (n=7).

Figure 4.41 provides information regarding how comfortable the participants feel when attending social activities.

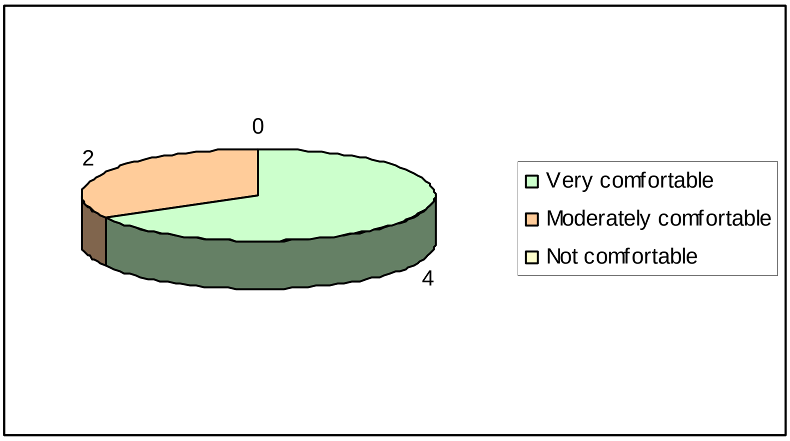


Figure 4.41: The participants' experience regarding how comfortable they are in social events (n=7).

The amount of social activities attended increased for all the participants since the cochlear implant was received. Four of the participants (Participants 1, 2, 5 and 6) indicated that the amount has greatly increased, whereas two (Participants 3 and 7) indicated only a slight increase. The participants also feel more comfortable in social situations since the use of the cochlear implant. Again four participants (Participants 1, 2, 6 and 7) reported that they feel much more comfortable and two participants (Participants 3 and 5) indicated that they are moderately comfortable in these situations. These results correlates with the generally expected outcomes for postlingually deafened adult cochlear implant users (Sanderson & Nash, 2001) and can therefore be regarded as a positive outcome of cochlear implantation in this population.

Self-confidence and self-consciousness are both aspects that have an impact on quality of life and were therefore investigated. Figure 4.42 and 4.43 present the results regarding these two aspects.

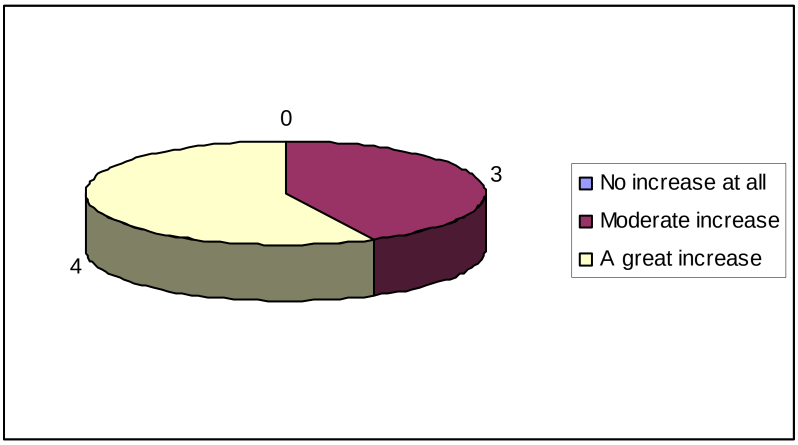


Figure 4.42: The change in the participants' self-confidence since the use of the cochlear implant (n=7).

Figure 4.43 presents the participants' change in terms of their self-consciousness since the use of the cochlear implant.

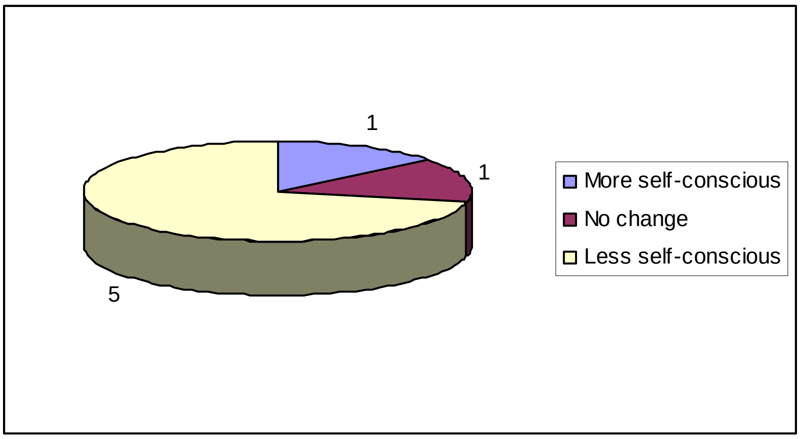


Figure 4.43: The change in the participants' self-consciousness since the use of the cochlear implant (n=7).

All the participants indicated that since the use of the cochlear implant their self-confidence has increased, but in varying degrees. Five of the participants (Participants 2, 4, 5, 6 and 7) also reported that they are less self-conscious since the use of the cochlear implant. Participant 1 felt that there was no change in self-consciousness, because she never felt self-conscious even before the implantation. Participant 3, however, indicated that she feels more self-conscious since the use of the cochlear implant, but did not give any reason as to why she is feeling this way. Zwolan, Kileny and Telian (1996) and Shea et al. (1990) also found that LIPD adults experience improved self-esteem, which includes more self-confidence and less self-consciousness. The results of this study therefore correlates with the literature.

As a conclusion to Section E, an open-ended question regarding their quality of life was presented. All the participants indicated that they feel positive regarding the cochlear implant when considering their quality of life. Participant 1 and 5 felt that they are more active socially since they are now able to communicate more effectively. Participant 2, 3 and 6 indicated that their self-confidence has improved, because they are able to understand more, communicate more successfully, and they feel more included in their social environment. Participant 4 also reported that she feels more included in the hearing world. Participant 7 stated that he has adapted much better in everyday and social situations since the use of the cochlear implant and also feels more confident.

Cochlear implants have a positive effect on quality of life among profoundly deaf adults (Mo, Lindbæk & Harris, 2005). The self-reported outcomes in terms of quality of life in the work, school, or place of study setting, as well as in social situations, also emphasize the positive effect of the cochlear implant on the LIPD adults' lives. These positive quality of life outcomes must be taken into account when the effectiveness of the cochlear implant in the LIPD population is considered. The improvement in general self-esteem, social functioning, and work-related areas could contribute to benefits to society and national economies (Sanderson & Nash, 2001). The improvements in cochlear implant users' quality of life may enable them to integrate more efficiently into the hearing society and especially the work-place. Families and prelingually deafened candidates could be informed during the counselling process that their quality of life may improve, and these aspects of the cochlear implant should be considered when a decision regarding the cochlear implant is made.

4.7 Conclusion

Controversy about implanting prelingually deafened adults is present within the South African context as well as internationally. The insufficient information regarding communication-related outcomes of LIPD adults poses a challenge to cochlear implant teams. It was the aim of this study to determine the self-reported and objectively assessed communication-related outcomes of LIPD adults.

The quantitative findings obtained from the objectively assessed results (formal test battery) were considered together with the qualitative findings obtained from the self-reported results (semi-structured interview). This method of triangulation played a constructive role in the integrated analysis of the results, therefore providing more comprehensive results.

When the results of the four sub-aims were integrated, the following outcomes were evident:

- The objectively assessed audiological, language, and speech intelligibility outcomes of the LIPD participants were poor. No or limited audition-alone open-set speech discrimination was obtained. Auditory-visual open-set speech discrimination was considerably better than the audition-alone speech discrimination, but could still not be regarded as good (sub-aim 1). Objectively assessed receptive and expressive language levels were lower than expected from the participants' chronological age (sub-aim 2). Speech production and speech intelligibility was negatively influenced by the incorrect production of consonants (Sub-aim 3).

- The self-reported results, however, indicated that the LIPD adults experience the cochlear implant as mostly positive. They are able to hear more environmental sounds, and the cochlear implant has improved their ability to listen to the television and music. Speech-reading and localization have also improved (sub-aim 1). Self-reported language skills have improved (sub-aim 2). The participants characterized their speech as "more controlled". They indicated that they are able to produce words better and consequently their speech intelligibility has improved since the use of the cochlear implant (sub-aim 3). Their quality of life in everyday situations, as well as in work related and social situations, has improved (sub-aim 4).

- It is therefore important to consider both the LIPD adults' self-reported and objectively assessed outcomes when the success of the cochlear implant is evaluated.

In this chapter the results obtained in this study were discussed according to the four specified sub-aims. The sub-aims were selected in an attempt to achieve the main aim of the study. The results obtained under each sub-aim were discussed and integrated with current literature to ascertain the validity thereof. The results of the study enabled the researcher to determine the objectively assessed and self-reported outcomes of the LIPD adults.

CHAPTER FIVE

CONCLUSIONS

5.1 Introduction

The main aim of the current study was to determine the communication-related outcomes of late-implanted, prelingually deafened (LIPD) adults. In this chapter, conclusions drawn from each sub-aim and the implications of the results will be discussed. The current study yielded a large amount of data on the communication-related outcomes of the LIPD adults, but also had limitations. These limitations will be discussed during a critical evaluation of the study. The chapter will be concluded with recommendations and indicators for further research.

5.2 Conclusions and Implications

5.2.1 Self-reported and objectively assessed audiological outcomes

Cochlear implants benefit appropriately selected prelingually deafened adults (Manrique et al., 1995). Because a cochlear implant has become an accepted treatment option to attempt to restore hearing to persons with severe hearing impairment, the audiological outcomes of the LIPD participants are of the most important to consider.

The participants' aided pure tone thresholds were established at between 25dB HL and 35dB HL in the frequency range of 250 Hz to 8000 Hz, which can be regarded as good outcomes for a cochlear implant user. In the light of these good thresholds, the implantation of LIPD adults could be considered appropriate and justified. After implantation, this population is able to hear everyday environmental sounds better than previously, which could have an impact on different aspects of their lives, for example, improve their safety. Their ability to perceive warning signals such as police sirens, house and car alarms, as well as a car horn, may enable them to function more independently within the hearing world. Furthermore, it will enable them to function optimally within the work setting, allowing them to hear a phone ringing or the doorbell. Cochlear implant users must, however, be able to perceive more complex and linguistically loaded signals in a hearing world. They must be able to receive and recognize the most complex and specialized of auditory signals, namely speech.

According to literature, the prognosis for adolescent and adult cochlear implant users with prelingual deafness to attain open-set speech discrimination is considered poor (Waltzman & Cohen, 1999). The participants in this study did not obtain optimal open-set speech discrimination and they were not able to understand speech by audition alone, neither in a quiet nor in a noisy environment. Their inability to perceive speech as an open-set signal will negatively influence their ability to communicate in most speech situations, such as in noisy rooms or when they cannot rely on their speech-reading skills due to poor visibility of the speaker's mouth. The results of the audiological assessment are supported by the self-reported data obtained from the participants. Self-reported open-set speech discrimination in conversation and on the telephone is experienced as negative. In this investigation, the use of the cochlear implant by the LIPD adults did not improve communication via the telephone and can therefore not be regarded as producing a desirable outcome. The implications of the inability to use a telephone, especially within the work setting, are significant and could prevent the LIPD adult from fully complying with the expectations and demands in a hearing society.

If the degree of benefit the LIPD individuals in this investigation receive from the cochlear implant is defined solely by audition-alone speech discrimination, it would not seem to be worthwhile or even cost-effective to implant prelingually deafened adults. It can be concluded that the prelingually deafened adults do not obtain significant benefit from the cochlear implant. The findings of this investigation may be used by the audiologist during the counselling process, both pre- and postoperatively, to prepare the prelingually deafened adult cochlear implant candidate and their families regarding the very likely possibility of poor open-set speech discrimination.

Audition-alone speech discrimination testing may not completely reflect the benefit a LIPD adult could obtain from the implant (Moody-Antonio et al., 2005). Visual cues, as a supplement to the auditory signal, may play a significant role in enhancing the understanding of the speech signal and when communicating (Clark, 2003). LIPD adult mostly makes use of both visual and auditory cues. From the findings of this investigation, it is evident that the LIPD adults present with improved speech discrimination when they apply both audition and visual cues in making sense of auditory information. In support of the objective audiological findings, the LIPD adults also indicated that they perceive their speech-reading abilities, in combination with their auditory input, as positive, and that using both modalities improves the meaningfulness of the cochlear implant. The combination of these modalities may lead to better communication interaction and inclusion in the hearing world. It is necessary, however, to highlight the fact that even though their audition-plus-vision speech discrimination is better than their audition-alone speech discrimination, the participants still do not obtain the optimal speech discrimination achieved by postlingually deafened cochlear implant users. Prelingually deafened adult candidates and their significant others could be informed about the enhancement in communication that may be experienced when both modalities are used and this information could lead to informed decision-making by both the candidate and the cochlear implant team.

It is important to consider all factors that may contribute to successful and unsuccessful cochlear implant use by the LIPD population (Zwolan, Kileny & Telian, 1996) and therefore certain self-reported outcomes were taken into consideration in this investigation. The participants perceive the use of the cochlear implant as positive. Self-reported work-related hearing skills with the cochlear implant may indicate that cochlear implantation could be meaningful to this population. Due to the importance of hearing within the work, school, or place of study setting, LIPD adults could use the cochlear implant for better work outcomes and consequently be integrated into the hearing work society with more success. The participants also experience their hearing in social situations as positive. Better outcomes in the working environment as well as in social situations may lead to better socioeconomic status and greater wellbeing for the LIPD adults. It may contribute to better social functioning and better inclusion into the hearing world. The results of this investigation show that the LIPD adults also experience that their localization abilities for sounds and speech have improved. These findings can be used by the cochlear implant team and the audiologist to counsel the candidates and recent implantees regarding the expected outcomes from the cochlear implant and guide them to better decision making.

5.2.2 Self-reported and objectively assessed language outcomes

The prelingually deafened adults' profound hearing impairment during the language-learning years result in deficits in their linguistic knowledge (Skinner et al., 1992) which contribute to delayed language skills. The lack of early auditory exposure and the mode of communication that the LIPD adults use, influence their oral receptive and expressive language negatively. The results obtained from the objective language assessments lead to the conclusion that the cochlear implant did not contribute to significant improvement in the participants' language skills. Implantation may not be worthwhile due to the poor oral language skills they continue to experience even after implantation. The implications of poor language skills are comprehensive and may have a significant impact on the LIPD participants' communication interaction. Their ability to understand all words and sentences in conversations are negatively influenced and this has an impact on their expressive communication.

The mode of communication before implantation and the type of schooling experienced by the LIPD adults in the investigation could explain or partly explain the poor objectively assessed language outcomes that were determined. These adults mostly made use of the same amount of spoken and Sign Language and were integrated into a school where the main mode of communication was Total Communication. They were therefore not exposed to auditory-oral communication, which is considered the optimal mode of communication when receiving a cochlear implant.

Although the participants demonstrated poor objectively assessed language outcomes, they did report that the cochlear implant improved their receptive and expressive language. These findings are supported by the results of research by Zwolan, Kileny and Telian (1996). The participants indicated that their language skills in everyday life, in the work setting, and in social situations have improved since they received the cochlear implant. These findings could therefore contribute to viewing outcomes of the cochlear implant in a more optimistic light and indicated that cochlear implants are of value to LIPD adults. The self-reported improvement in their language skills could cascade into better communication and better integration into the hearing world.

The audiologist could use both these objective and self-reported outcomes in the counselling process to inform the prelingually deafened adult candidates and their significant others regarding the expected outcomes, in order to facilitate realistic expectations. Auditory rehabilitation postoperatively should also be discussed and the candidates ought to be encouraged to attend regular speech-language therapy after the cochlear implant has been received.

5.2.3 Self-reported and objectively assessed speech intelligibility outcomes

It is widely known that the ability of LIPD adults to use the electrically coded speech information provided by the cochlear implant for speech production and intelligibility is poorer than the ability of postlingually deafened adults (Busby, Roberts, Tong & Clark, 1991). It was evident that the speech intelligibility and speech production of the LIPD participants are poor. The participants with better predictive factors, such as a later age of deafness and longer use of the cochlear implant, also presented with the best speech intelligibility and production. Most of the participants experience problems with the production of the middle and back single sound consonants, and typical speech errors are the substitutions of sound with a simplified sound or the deletion of the sound in the stimulus word. According to literature, these errors often occur in the LIPD adult population (Busby et al., 1991). Sound combinations in both the initial and final position of words were produced with difficulty and errors, such as substitutions, additions, and deletions, were observed. Based on the formal speech intelligibility findings, the speech intelligibility and production of consonants of the participants are less than optimal. It could indicate that the use of the cochlear implant did not improve their speech intelligibility in a significant manner. Verbal communication, which includes good speech intelligibility, is necessary for integration into the hearing world. The objectively assessed outcomes indicate that the LIPD adults may experience problems within working and social situations, due to their poor speech intelligibility. However, when considering the self-reported speech intelligibility outcomes, it is evident that the LIPD adults did experience an improvement in their speech intelligibility skills.

A significant finding of this study was that the LIPD adults as well as their significant others experience that the cochlear implant users' speech intelligibility improved since they received the cochlear implant. This could indicate that the cochlear implant may be meaningful to this population. The LIPD adults' self-reported perceptions regarding this area of communication could therefore indicate that improvements in these areas may contribute to better functioning within the working and social world.

The audiologist on the cochlear implant team should consider all of these results in the preparation and counselling of the prelingually deafened adult candidates. It is important that both the negative audiological assessment and the positive self-reported outcomes should be discussed and weighted against all the other results, in order to facilitate better and informed decision making. Speech therapy is a necessary part of the auditory rehabilitation process and the audiologist should encourage the candidate pre- and postoperatively to attend training sessions, especially for speech intelligibility.

Furthermore, it is recommended that the Pretoria Cochlear Implant Programme consider the use of speech production and speech intelligibility as a measure of candidacy for prelingually deafened adults. From the findings, it is evident that the speech intelligibility and mode of communication the participants used before implantation may influence the postoperative speech intelligibility outcomes. It is therefore important to consider these skills when candidacy is discussed, as they may contribute to the possibility of better speech intelligibility outcomes postoperatively.

5.2.4 Self-reported quality of life outcomes

It is known that cochlear implants have a positive impact on quality of life among profoundly deaf adults (Mo, Lindbæk & Harris, 2005) and when considering the cascades of outcomes as described by Sanderson and Nash (2001), enhanced social independence and quality of life in adulthood is regarded as long-term benefits that can be expected. The LIPD participants' self-reported outcomes regarding quality of life in everyday situations were positive and could indicate that the cochlear implant has a significant and meaningful effect on this population. Their perception of more independence and better relationships with their family and friends could indicate unmistakably improved quality of life. Therefore, implanting this population may lead to their better integration and more active participation in the hearing society.

The self-reported quality of life outcomes as experienced in the work, school, and place of study settings, as well as in social situations, furthermore demonstrate the positive effect the cochlear implant has on the LIPD adult population. These positive quality of life outcomes could lead to a positive view of the cochlear implant as meaningful to the LIPD adults. This population's improved self-esteem, greater self-confidence and better functioning within work and social settings could contribute to society, both economically and functionally (Sanderson & Nash, 2001).

These quality of life outcomes could be used by the audiologist during the candidacy process. The prelingually deafened adult candidates and their families can be encouraged by the possible outcomes in quality of life that can be expected after implantation. Informed decision making regarding the cochlear implant must include considering all the different outcomes that can be expected, both positive and negative.

5.2.5 Summary of objectively assessed and self-reported outcomes

In conclusion, a summary of the outcomes, as determined in this study, is visually presented in Table 5.1. The advantages and disadvantages of cochlear implant use in the LIPD adult population are highlighted.

Table 5.1 Summary of communication-related outcomes for the LIPD adult since the use of the cochlear implant

OUTCOME AREA	ADVANTAGES	DISADVANTAGES
Audiological functioning:	• Aided pure tone thresholds are between 25dB HL and 35dB, which can be regarded as appropriate and adequate for cochlear implant users • Auditory-visual open-set speech discrimination is considerably better than audition-alone open-set speech discrimination • Self-reported listening to the television and music has improved • Self-reported ability to recognize environmental sounds has improved • Self-reported ability to listen in the work and social settings has improved • Speech-reading skills have improved • A moderate improvement in localization of sounds and speech was experienced	• No or limited audition-alone open-set speech discrimination is present • Auditory-visual open-set speech discrimination is still poorer than that of postlingually deafened cochlear implant users • Limited benefit was experienced when listening to the radio • Self-reported ability to recognize speech has not improved • Self-reported ability to understand different speakers on the telephone has not improved • Without speech-reading, they have limited understanding
Language outcomes:	• Self-reported receptive and expressive language skills have improved • Self-reported language at work and in social situations has improved	• Objectively assessed receptive and expressive language levels are significantly lower than the expected language level for their chronological ages
Speech intelligibility outcomes:	• Self-reported speech characteristics after implantation indicated that the LIPD adults experienced their speech and voice as more controlled • Self-reported pronunciation of words, experienced by other people, has improved	• Objectively assessed speech production of consonants is poor and problems are mostly experienced in the production of middle and back sounds, as well as sound combinations • Objectively assessed speech intelligibility indicated that most of the LIPD adults' speech

	• Self-reported speech intelligibility, experienced by other people, has improved	is unintelligible, but can be understood by experienced listeners
Quality of Life outcomes:	• Quality of life in everyday situations improved. The LIPD adults indicated that their tasks in daily life are easier and that they are more independent • Relationships with family, partners and friends have improved • Quality of life in the work, school, or place of study setting has improved. The LIPD adults' relationships with co-workers, teachers and lecturers have improved, as well as their satisfaction with their employment • Quality of life in social situations also has improved. The LIPD adults are less isolated and less embarrassed • The LIPD adults' social activities have increased and they feel more comfortable in social situations • The LIPD adults are more self-confident and less self-conscious	• No disadvantages were reported since the use of the cochlear implant

These advantages and disadvantages of implanting the prelingually deafened adults once again underscore the importance of taking all the different aspects of implantation into consideration, especially for determining candidacy and for counselling. The audiological outcomes indicate that the participants experienced poor audiological functioning, due to their inability to have audition-alone open-set speech discrimination and consequently more audiological disadvantages were noted. The language and speech intelligibility outcomes indicate that, objectively assessed, the participants did not obtain optimal outcomes, but when considering self-reported outcomes, the participants experience positive outcomes in most of these areas of communication. It is also evident that the LIPD adult participants' quality of life has improved when considering the advantages that they indicated during the investigation. No disadvantages since using the cochlear implant were reported regarding the quality of life of the participants.

5.3 Critical evaluation of the investigation

The research study was critically evaluated and as in most research investigations, limitations in the current study were observed. The limitations of this study are as follows:

Firstly, due to logistic reasons, only the LIPD adults of the Pretoria Cochlear Implant Programme (PCIP) were used in the study and results therefore only reflect the communication-related outcomes of this population in this specific programme. However, the PCIP is unique in the fact that the members are more prepared than in other programmes to broaden their selection criteria. They therefore have more LIPD adults who would not have been considered by other programmes.

Secondly, more comparative information could have been obtained, if pre- and postoperative data was available. Unfortunately the preoperative data was not available and the same formal standardized tests were not used with all the participants prior to the investigation.

Lastly, language barriers between the researcher and the participants posed a challenge during some of the data collection procedures. All the participants made use of Sign Language and if the semi-structured interview had been supplemented with Sign Language, easier comprehension could have been established in some cases. The pilot study, however, enabled the researcher to simplify the language according to the language competence level of the LIPD adults and consequently reduced the language difficulties that could have been present.

On the whole, the study yielded valuable and useful information for the field of cochlear implants. The study provided unique data regarding the LIPD population within the South African context. The in-depth analysis of each of the participants' communication-related skills could provide insight into the expected outcomes of this population and may contribute to preparing both cochlear implant team and future prelingually deafened adult candidates regarding appropriate expectations and responsibilities after cochlear implantations. Determining the quality of life outcomes provided valuable information regarding this aspect of the LIPD participants' lives. Surprising and positive information was reported about implantation of this population.

5.4 Recommendations for future research

The methodology and research findings in a specific area of research may lead to new questions and the need for information, and consequently recommendations for further research can be made. The following recommendations can be made for future research:

The LIPD population's outcomes in different cochlear implant programmes within South Africa could be considered for future research and comparisons can be made. Factors contributing to better or poorer results may be recognized and could guide cochlear implant programmes in better decision making regarding the implantation of this specific population. Universal candidacy criteria may be established. As stated by Zwolan, Kileny and Telian (1996), it is important to look at factors that contribute to successful and unsuccessful cochlear implant use by prelingually deafened adults. Having a better understanding of factors that contribute to implant use and satisfaction by prelingually deafened adults may help to prevent implantation of inappropriate individuals.

For future purposes, the same objective methodology could be considered for use both pre- and postoperatively in the LIPD population. Based on the comparison between pre- and postoperative data, a protocol can be proposed in order to facilitate easier decision making by the cochlear implant programme regarding important candidacy issues related to the prelingually deafened population. The value of using the proposed protocol as part of the cochlear implant candidate selection procedure for the Pretoria Cochlear Implant Team can be determined.

An important aspect of the LIPD adult population that should be examined in more depth is the issue regarding auditory rehabilitation. Future research could be conducted regarding the perceptions and barriers to continuous and consistent postoperative auditory rehabilitation for LIPD adults. Rehabilitation is very important after cochlear implantation and can contribute to obtaining maximum benefits from the cochlear implant (Clark, 2003). It could be valuable for a cochlear implant programme to determine what factors and aspects should be addressed in order to encourage the LIPD adults to continue with auditory rehabilitation after implantation, and to create realistic expectations regarding this issue.

5.5 Closing Statement

LIPD adults present a greater challenge to cochlear implant teams than do postlingually deafened adults (Zwolan, Kileny & Telian, 1996) and therefore it is vital to determine all the outcomes of this population. The analysis of communication-related outcomes can contribute to better understanding of this population and consequently aid the cochlear implant programme preoperatively in better candidacy measurements and counselling of the prelingually deafened adult candidates and their significant others. Postoperatively, the audiologist could also use the outcomes of this study to counsel the new prelingually deafened cochlear implant users in their expectations, and encourage them to comply with certain auditory rehabilitation requirements. In the study it was evident that the objectively assessed outcomes indicated that the LIPD adults' skills were not appropriate according to what is expected of a good cochlear implant user. The self-reported outcomes, however, highlighted the fact that the cochlear implant provided this population with improved skills. Therefore, the importance of determining all the factors that may contribute to successful and unsuccessful cochlear implant use by the prelingually deafened adult population should be emphasized. The controversy surrounding the implantation of the prelingually deafened adults can best be resolved by careful documentation of the outcomes and in doing so researchers will enable cochlear implant programmes to realize the full potential of cochlear implants for prelingually deafened adults (Zwolan, Kileny & Telian, 1996). The outcomes of this population determined in this study could therefore contribute to better decision making within the cochlear implant programme and by the future prelingually deafened adult candidates.

"An elder and motivated pre-lingual or congenital deaf who is aware of the difficulties of the task to undertake can still be exceptionally *considered as candidate for cochlear implantation."* (Kos, Deriaz, Guyot & Pelizzone, 2008: 193)

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Appendix A:

Letter to Head of the Pretoria Cochlear Implant Program

Universiteit van Pretoria

Departement Kommunikasiepatologie
Spraak- Stem- en Gehoorkliniek
Tel : +27 12 420 2490
Faks : +27 12 420 3517
E-posadres : catherine.vandijk@up.ac.za

Prof. J.G. Swart
Hoof: Pretoria Kogleêre Inplantingsprogram
Oor, Neus en Keel Hospitaal
Skinner Straat
Pretoria
0002

Oktober 2006

Geagte Professor Swart,

TOESTEMMING VIR DIE UITVOERING VAN 'N NAVORSINGSPROJEK WAT LAAT-GEÏNPLANTEERDE PRELINGUALE DOWE VOLWASSENES MET 'N KOGLEÊRE INPLANTING, VERBONDE AAN DIE PRETORIA KOGLEÊRE INPLANTINGSPROGRAM, BETREK.

Ek is tans 'n nagraadse spraak-taalterapie en oudiologie student by die Departement Kommunikasiepatologie verbonde aan die Universiteit van Pretoria. Die doel van hierdie studie is om die self-gerapporteerde en objektiewe geëvalueerde kommunikasie-verwante uitkomste van kogleêre inplantingsgebruik deur laat-geïnplanteerde prelinguale dowe volwassenes, te ondersoek en beskryf.

Die studie sluit die uitvoering van 'n volledige oudiologiese, spraak- en taal evaluasie op die prelinguale dowe volwassenes met 'n kogleêre inplanting, in. Die deelnemers sal ook aan 'n gestruktureerde onderhoud deelneem wat sal fokus op hul ervarings aangaande die gebruik van die kogleêre inplanting. Die deelname is vrywillig en die deelnemers mag op enige stadium aan die studie onttrek. Al die inligting wat ingesamel word, sal vertroulik hanteer word en die identiteit van die deelnemers sal deurgaans beskerm word.

Inligting vanuit die kliënte rekords sal die navorser van hulp verskaf ten einde die navorsingsvraag beter te beantwoord en toestemming vir toegang tot hierdie rekords word versoek. Die inligting wat tydens die studie ingesamel word, sal deur die Pretoria Kogleêre Inplantingsprogram aangewend kan word ten einde beter dienslewering aan hierdie populasie te verseker en moontlike prelinguale dowe kandidate beter in te lig aangaande moontlike uitkomstes wat verwag kan word. Die inligting sal gepubliseer word as 'n artikel en deel vorm van my verhandeling. Volgens internasionale en Universiteit van Pretoria vereistes sal die versamelde data gestoor word vir 'n periode van 15 jaar.

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Ek sal dit waardeer as u my toestemming verleen om die prelinguale dowe volwassenes verbonde aan u kogleêre inplantingsprogram in my studie te betrek. U sal gevra word om 'n toestemmingsbrief te teken, waarvan u ook 'n kopié sal ontvang. Vir enige verdere navrae, kontak my gerus by 072 298 4944.

Ek vertrou dat u my versoek gunstig sal oorweeg.

Vriendelike groete,

Liani van der Westhuizen
M. Kommunikasiepatologie student

Dr. Catherine van Dijk
Navorsingsleier

Mev. Emily Groenewald
Mede-Navorsingsleier

Professor Brenda Louw
HOOF: DEPT KOMMUNIKASIEPATOLOGIE

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TOESTEMMINGSBRIEF

Geagte Me. Liani van der Westhuizen, Datum: 27/10/2006

Hiermee gee ek u toestemming vir die uitvoering van u navorsingsprojek wat prelinguale dowe volwassenes van die Pretoria Kogleêre Inplantingsprogram sal betrek. Sien asseblief toe dat die deelnemers bewus daarvan is dat die deelname aan u studie volkome vrywillig is. Voorwaardes geld soos in bostaande brief uiteengesit.

Vriendelike groete,

Prof. J.G. Swart
Hoof: Pretoria Kogleêre Inplantingsprogram

Appendix B:

Letters relating to Ethics Committee

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Universiteit van Pretoria
Navorsingsvoorstel- en Etiekkomitee
Fakulteit Geesteswetenskappe

30 Januarie 2007

Beste dr Van Dijk

Projek:	***Communication-related outcomes of cochlear implant use by late-implanted prelingually deafened adults***
Navorser:	**L van der Westhuizen**
Leier:	**Dr C van Dijk**
Departement:	**Kommunikasiepatologie**
Verwysingsnommer:	**22026348**

Baie dankie vir die aansoek wat u voorgelê het aan die Navorsingsvoorstel- en Etiekkomitee, Fakulteit Geesteswetenskappe.

Die uiters voorbeeldige aansoek is op 25 Januarie 2007 formeel deur die Komitee goedgekeur. Die goedkeuring word verleen onderhewig aan die voorwaarde dat die kandidaat wel die navorsing volgens die beginsels en binne die parameters soos in die aansoek en navorsingsvoorstel deur haar uiteengesit, sal uitvoer.

Die Komitee wil u graag versoek om bogenoemde goedkeuring aan me Van der Westhuizen oor te dra.

Ons wens u sukses met die projek toe.

Vriendelike groete

Brenda Louw

Prof Brenda Louw
Voorsitter: Navorsingsvoorstel- en Etiekkomitee
Fakulteit Geesteswetenskappe
UNIVERSITEIT VAN PRETORIA

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Universiteit van Pretoria
Navorsingsvoorstel- en Etiekkomitee
Fakulteit Geesteswetenskappe

30 Januarie 2007

Beste dr Van Dijk

Navorser: L van der Westhuizen

Verder tot die goedkeuringsbrief, wil die Komitee graag van die geleentheid gebruik maak om u geluk te wens met die uiters voorbeeldige aansoek.

Vriendelike groete

Brenda Louw

Prof Brenda Louw
Voorsitter: Navorsingsvoorstel- en Etiekkomitee
Fakulteit Geesteswetenskappe
UNIVERSITEIT VAN PRETORIA

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Appendix C:

Informed Consent Forms

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Department of Communication Pathology
Speech, Voice and Hearing Clinic
Tel: +27 12 420 2490
Fax : +27 12 420 3517
Email : catherine.vandijk@up.ac.za

October 2006

Dear Sir/Madam

REQUEST FOR YOUR PARTICIPATION IN THE RESEARCH PROJECT

I am currently a postgraduate student at the Department of Communication Pathology at the University of Pretoria. The title of my study is: Communication-related outcomes of cochlear implant use by late-implanted prelingually deafened adults. I would appreciate it if you would be willing to participate in this existing project. Please see details of this research project below:

Purpose of the study:
The purpose of this study is to determine the self-reported and objectively assessed outcomes of late-implanted prelingually deafened adults regarding cochlear implant use.

Procedure:
You will be requested to participate in an audiological, speech and language evaluation that will objectively assess your above-mentioned abilities. The duration of this evaluation will last approximately two hours. You will also be expected to participate in an interview on the same day of the evaluation.

Risks and discomforts:
There are no risks involved in this study and the interview will take approximately 30 minutes. You will be expected to attend the audiological, speech and language evaluation. The date of the evaluation will be arranged to suit you.

Value of the study:
The results of this study may help members of cochlear implant teams and other parties to gain better understanding regarding the self-reported and objective outcomes associated with cochlear implant use from late-implanted prelingually deafened adults. Your specific experiences and needs would thus be determined and this information can possibly contribute to better service delivery to prelingually deafened adults with cochlear implants.

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Participant's right:
Your participation in this study is voluntary and although you may benefit from the re-evaluation of your auditory skills you will not receive any reward for your participation. You will however have the right to withdraw from participating in this study at any time. Information from your personal file will be used to assist the researcher to investigate the research question and your permission to utilize the file is therefore requested.

Confidentiality:
The information that you will provide will be treated with confidentiality and your identity will be protected at all times (only information that you provide in the interview will be used for the study and not your name or personal details). According to international and University of Pretoria requirements the information obtained during the research study will be stored for a period of 15 years.

If you have any questions or concerns, please feel free to contact me, Liani van der Westhuizen, at 072 298 4944 at any time.

I trust that my request will be favorably considered.

Kind regards,

LWesthuizen
Liani van der Westhuizen
M.Communication Pathology Student

Dr. Catherine van Dijk
Research Supervisor

Mrs. Emily Groenewald
Co-Research Supervisor

Professor Brenda Louw
HEAD: DEPT OF COMMUNICATION PATHOLOGY

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Consent Form

Dear Sir/Madam

Kindly read the following statements and indicate with a cross (X) whether you are willing to participate in the above-mentioned study.

- I have heard the purpose of the study as well as the procedure to be followed and was provided with an opportunity to ask questions and given ample time to consider my participation.
- I understand the purpose and procedures of the study and I have not been pressurized in any way to participate.
- I understand that participation is voluntary and that I may withdraw from the study at any time without providing any reasons.
- I know that ethical clearance was obtained from the Research Proposal and Ethics Committee at the University of Pretoria and from the head of the Pretoria Cochlear Implant Program.
- I am aware that the results of this study may be published, but that all my personal details will be kept confidential.

I am willing to participate in this study. I understand the above-mentioned terms and conditions.

Yes ☐ No ☐

____
Participant's signature

____
Date

Universiteit van Pretoria

Oktober 2006

Geagte Heer/Dame

TOESTEMMING VIR U DEELNAME AAN DIE NAVORSINGSPROJEK

Ek is tans 'n nagraadse student by die Departement Kommunikasiepatologie verbonde aan die Universiteit van Pretoria. Die titel van my studie is: Kommunikasie-verwante uitkomste van kogleêre inplantingsgebruik deur laat-geïnplanteerde prelinguale dowe volwassenes. Ek sal dit hoog op die prys stel indien u bereid sou wees om deel te neem aan hierdie navorsingsprojek. Sien asb. onderstaande inligting aangaande hierdie projek.

Doel van die studie:
Die doel van die studie is om te bepaal wat die self-gerapporteerde en objektief geassesseerde uitkomste van kogleêre inplantingsgebruik deur laat-geïnplanteerde prelinguale dowe volwassenes, is.

Prosedure:
Daar gaan van u verwag word om deel te neem aan 'n oudiologiese-, spraak- en taalevaluasie wat hierdie vaardighede van u objektief sal evalueer. Hierdie evaluasie sal ongeveer twee ure duur. Daar sal ook van u verwag word om 'n deel te neem aan 'n onderhoud op dieselfde dag wat die evaluasie plaasvind. Hierdie brief van ingeligte toestemming sal tydens die besoek terug besorg word aan die navorser. Daar sal met u, as deelnemer, 'n gepaste tyd ooreengekom word.

Risiko's en ongerief:
Daar is geen risiko's verbonde aan hierdie studie nie. Die voltooiing van die onderhoud sal ongeveer 30 minute duur. Daar sal wel van u verwag word om aan 'n oudiologiese, spraak en taal evaluasie deel te neem. Daar sal 'n datum met u ooreengekom word wat vir u gerieflik sal wees.

Waarde van studie:
Die resultate van hierdie studie sal moontlik die lede van kogleêre inplanting spanne en ander party help om die self-gerapporteerde en objektiewe uitkomste geassosieër met kogleêre inplantingsgebruik van laat-geïnplanteerde prelinguale dowe volwassenes beter te verstaan. Daar kan sodoende bepaal word wat u spesifieke ervarings en behoeftes is. Hierdie inligting kan moontlik bydra tot meer

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effektiewe dienslewering aan laat-geïnplanteerde prelinguale dowe volwassenes met kogleêre inplantings.

Regte van die deelnemer:
U deelname aan die studie is vrywillig en hoewel u voordeel kan verkry vanuit die herevaluasie van u ouditiewe vaardighede sal u geen beloning daarvoor ontvang nie. U het egter die volle reg om enige tyd te besluit om aan die studie te onttrek. Inligting vanuit u persoonlike leêr aangaande u koglêere inplanting sal vir die navorser van waarde wees in die beantwoording van die navorsingsvraag en u toestemming vir die gebruik daarvan word versoek.

Vertroulikheid:
Al die inligting wat u gee en u persoonlike besonderhede gaan baie vertroulik hanteer (slegs inligting wat tydens die onderhoud deurgegee is sal vir die studie gebruik word). Volgens internasionale en Universiteit van Pretoria vereistes sal die inligting wat verkry in tydens die navorsingstudie gestoor word vir 'n periode van 15 jaar.

Indien u enige verdere vrae of bekommernisse het, kan u enige tyd vir my, Liani van der Westhuizen skakel by 072 298 4944.

Ek vertrou dat u my versoek gunstig sal oorweeg.

Vriendelike groete,

LWesthuizen
Liani van der Westhuizen
M Kommunikasiepatologie Student

Dr. Catherine van Dijk
Navorsingsleier

Mev. Emily Groenewald
Mede-Navorsingsleier

Professor Brenda Louw
HOOF: DEPT KOMMUNIKASIEPATOLOGIE

Toestemmingsvorm

Geagte Heer/Dame

U word vriendelik versoek om die volgende stellings noukeurig deur te lees en deur middel van 'n kruisie (X) aan te dui of u bereid is om aan die bogenoemde studie deel te neem.

- Ek is ingelig aangaande die doel van die studie en die prosedures daaraan verbonde en is voorsien van genoegsame geleentheid en tyd om vrae te vra en te besluit oor my deelname.
- Ek verstaan die doel en die prosedures van die studie en was onder geen omstandighede onder druk geplaas om aan die studie deel te neem nie.
- Ek verstaan dat die deelname in hierdie studie vrywillig is en dat ek enige tyd van die studie kan onttrek sonder die verskaffing van enige rede.
- Ek weet dat etiese klaring verkry is vanaf die Etiese Navorsingskomitee, sowel as van die hoof van die Pretoria Kogleêre Inplantingsprogram.
- Ek is bewus daarvan dat die resultate van die studie gepubliseer mag word en dat al my persoonlike besonderhede vertroulik hanteer sal word.

Ek is bereid om deel te neem aan hierdie studie.

Ja ☐ Nee ☐

__________________________ _____________
Handtekening van deelnemer Datum

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Email : catherine.vandijk@up.ac.za

October 2006

Dear Sir/Madam

REQUEST FOR YOUR CHILD'S PARTICIPATION IN THE RESEARCH PROJECT

I am currently a postgraduate student at the Department of Communication Pathology at the University of Pretoria. The title of my study is: Communication-related outcomes of cochlear implant use by late-implanted prelingually deafened adults. Adolescents from the age of 16 are regarded as adult language users and therefore your child can be used as possible participant in this study. I would appreciate it if you would be willing to give your informed consent for your child to participate in this existing project. Please see details of this research project below:

Purpose of the study:
The purpose of this study is to determine the self-reported and objectively assessed outcomes of late-implanted prelingually deafened adults regarding cochlear implant use.

Procedure:
Your child will be requested to participate in an audiological, speech and language evaluation that will objectively assess his/her above-mentioned abilities. The duration of this evaluation will last approximately two hours. An appropriate and suitable time will be arranged. He/she will also be expected to participate in an interview. On the arranged date, this letter of consent can be presented back to the researcher.

Risks and discomforts:
There are no risks involved in this study and the interview will take approximately 30 minutes. Your child will be expected to attend the audiological, speech and language evaluation. The date of the evaluation will be arranged according to what suit you the best.

Value of the study:
The results of this study may help members of cochlear implant teams and other interested parties to gain better understanding regarding the self-reported and objective outcomes associated with cochlear implant use from late-implanted prelingually deafened adults. Your child's specific experiences and needs would thus be determined and this information can possibly contribute to better service delivery to prelingually deafened adults with cochlear implants.

Participant's right:
Your child's participation in this study is voluntary and although he/she may benefit from the re-evaluation of his/her auditory skills he/she will not receive any reward for his/her participation. He/she will however have the right to withdraw from participating in this study at any time. Information from your child's personal file will be used to assist the researcher to investigate the research question and your permission to utilize this file is therefore requested.

Confidentiality:
The information that your child will provide will be treated with confidentiality and his/her identity will be protected at all times (only information that he/she provide in the interview will be used for the study and not his/her name or personal details). According to international and University of Pretoria requirements the information obtained during the research study will be stored for a period of 15 years.

If you have any questions or concerns, you may contact me, Liani van der Westhuizen, at 072 298 4944 at any time.

I trust that my request will be favorably considered.

Kind regards,

Liani van der Westhuizen
M Communication Pathology Student

Dr. Catherine van Dijk
Research Supervisor

Mrs. Emily Groenewald
Co-Research Supervisor

Professor B. Louw
HEAD: DEPT. COMMUNICATION PATHOLOGY

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PARENT INFORMED CONSENT:

I, ______________________________, hereby agree that my child, ___________________ may participate in the above-mentioned study according to conditions stipulated in the accompanying letter.

_________________________ ____________________
Parent's signature Date

Universiteit van Pretoria

Departement Kommunikasiepatologie
Spraak- Stem- en Gehoorkliniek
Tel : +27 12 420 2490
Faks : +27 12 420 3517
E-posadres : catherine.vandijk@up.ac.za

Oktober 2006

Geagte Heer/Dame

TOESTEMMING VIR DIE DEELNAME VAN U KIND AAN DIE NAVORSINGSPROJEK

Ek is tans 'n nagraadse student by die Departement Kommunikasiepatologie verbonde aan die Universiteit van Pretoria. Die titel van my studie is: Kommunikasie-verwante uitkomste van kogleêre inplantingsgebruik deur laat-geïnplanteerde prelinguale dowe volwassenes. Tieners word vanaf die ouderdom van 16 jaar geag as volwasse taalgebruikers en daarom sal u kind gebruik kan word as moontlike deelnemer in hierdie studie. Ek sal dit hoog op die prys stel indien u bereid sou wees om toestemming te verskaf vir u kind om deel te neem aan hierdie navorsingsprojek. Sien asb. onderstaande inligting aangaande hierdie projek.

Doel van die studie:
Die doel van die studie is om te bepaal wat die self-gerapporteerde en objektief geassesseerde uitkomste van kogleêre inplantingsgebruik deur laat-geïnplanteerde prelinguale dowe volwassenes, is.

Prosedure:
Daar gaan van u kind verwag word om deel te neem aan 'n oudiologiese-, spraak- en taalevaluasie wat hierdie vaardighede van hom/haar objektief sal evalueer. Hierdie evaluasie sal ongeveer twee ure duur. Daar sal ook van hom/haar verwag word om deel te neem aan 'n onderhoud op dieselfde dag wat die evaluasie plaasvind. Die brief van ingeligte toestemming sal hiertydens terug besorg word aan die navorser. Daar sal met u kind, as deelnemer, 'n gepaste tyd ooreengekom word.

Risiko's en ongerief:
Daar is geen risiko's verbonde aan hierdie studie nie. Die voltooiing van die onderhoud sal ongeveer 30 minute duur. Daar sal wel van u kind verwag word om aan 'n oudiologiese-, spraak- en taalevaluasie deel te neem. Daar sal 'n datum met u ooreengekom word wat vir beide u en u kind gerieflik sal wees.

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YUNIBESITHI YA PRETORIA

Waarde van studie:
Die resultate van hierdie studie sal moontlik die lede van kogleêre inplanting spanne en ander party help om die self-gerapporteerde en objektiewe uitkomste geassosieër met kogleêre inplantingsgebruik van laat-geïnplanteerde prelinguale dowe volwassenes beter te verstaan. Daar kan sodoende bepaal word wat u kind se spesifieke ervarings en behoeftes is. Hierdie inligting kan moontlik bydra tot meer effektiewe dienslewering aan laat-geïnplanteerde prelinguale dowe volwassenes met kogleêre inplantings.

Regte van die deelnemer:
U kind se deelname aan die studie is vrywillig en hoewel hy/sy voordeel kan verkry vanuit die herevaluasie van sy/haar ouditiewe vaardighede sal hy/sy geen beloning daarvoor ontvang nie. Hy/sy het egter die volle reg om enige tyd te besluit om aan die studie te onttrek. Inligting vanuit u kind se persoonlike leêr aangaande sy/haar koglêere inplanting sal vir die navorser van waarde wees in die beantwoording van die navorsingsvraag en u toestemming vir die gebruik daarvan word versoek.

Vertroulikheid:
Al die inligting wat u kind gee en sy/haar persoonlike besonderhede gaan baie vertroulik hanteer word (slegs inligting wat tydens die onderhoud deurgegee is sal vir die studie gebruik word). Volgens internasionale en Universiteit van Pretoria vereistes sal die inligting wat verkry in tydens die navorsingstudie gestoor word vir 'n periode van 15 jaar.

Indien u enige verdere vrae of bekommernisse het, kan u enige tyd vir my, Liani van der Westhuizen skakel by 072 298 4944.

Ek vertrou dat u my versoek gunstig sal oorweeg.

Vriendelike groete,

Liani van der Westhuizen
M Kommunikasiepatologie Student

Dr. Catherine van Dijk
Navorsingsleier

Mev. Emily Groenewald
Mede-Navorsingsleier

Professor Brenda Louw
HOOF: DEPT KOMMUNIKASIEPATOLOGIE

INGELIGTE TOESTEMMING: Ouer

Hiermee gee ek, ____________________________, toestemming dat my kind, _________________________, mag deelneem aan die bogenoemde studie in ooreenstemming met inligting verstrek in die meegaande brief.

______________________ Handtekening van ouer

_______________ Datum

Oktober 2006

Naam van deelnemer: ____________________

Naam van navorser: Liani van der Westhuizen

Kommunikasie-verwante uitkomste van kogleêre inplantingsgebruik deur laat-geïnplanteerde prelinguale dowe volwassenes

INSTEMMINGSBRIEF: Deelnemer

- Ek verstaan dat ek, as 16 jarige tiener, geag word as 'n volwasse taalgebruiker en daarom kan ek in hierdie studie as deelnemer gebruik word.
- Die doel van die studie is om uit te vind wat my, 'n laat-geïnplanteerde prelinguale dowe volwassene se self-gerapporteerde en objektief geassesseerde uitkomste van my kogleêre inplantingsgebruik, is.
- Daar gaan van my verwag word om aan 'n oudiologiese-, spraak- en taalevaluasie deel te neem om sodoende objektief te bepaal wat my bogenoemde vaardighede is. Op dieselfde dag sal ek deelneem aan 'n onderhoud wat handel oor my ervarings aangaande die gebruik van 'n kogleêre inplanting. Hierdie instemmingsbrief sal op dieselfde dag van die evaluasie terug besorg word aan die navorser.
- Daar is geen risiko's verbonde aan hierdie studie nie. Die deelname aan die onderhoud gaan nie lank duur nie. Die datum sal gereël word om beide my ouers en my te pas.
- Ek neem vrywillig deel aan die studie en aanvaar dat ek geen beloning daarvoor gaan ontvang nie.
- Ek het die volle reg om enige tyd te besluit om nie meer deel te neem aan die studie nie.
- My ouers moet skriftelike toestemming gee dat ek aan die studie mag deelneem, aangesien ek minderjarig is (jonger as 21 jaar).
- Alle inligting wat ek gaan gee, gaan baie vertroulik hanteer word en ek sal anoniem bly.
- Die inligting wat ek tydens die onderhoud deurgegee het en weergegee het tydens die evaluasie mag gebruik word vir die studie, maar nie my naam of persoonlike inligting nie.
- Ek gaan vir die navorser waardevolle inligting verskaf aangaande die gebruik van 'n kogleêre inplanting, en dit sal bepaal wat ons spesifieke behoeftes en voorstelle is.

Indien ek enige verdere vrae of bekommernisse het, kan ek enige tyd vir Liani van der Westhuizen skakel by 072 298 4944.

Groete,

Handtekening van die deelnemer: ____________________
Datum: ____________________

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October 2006

Name of participant: ____________________

Name of researcher: Liani van der Westhuizen

Communication-related outcomes of cochlear implant use by late-implanted prelingually deafened adults.

INFORMED ASSENT: Participant

- I understand that I, as adolescent at the age of 16 years, am regarded as an adult language user and therefore can be used as participant in this study.
- The purpose of the study is to determine what my self-reported and objectively assessed outcomes with a cochlear implant are, as a late-implanted prelingually deafened adult.
- I will be requested to participate in an audiological, speech and language evaluation that will objectively assess my above-mentioned abilities. I also will have to participate in an interview and deliver this letter of consent back to the researcher on the day of the evaluation.
- There are no risks involved in this study and it will not take long to complete the interview. A date for the evaluation will be arranged to suit both my parents and me.
- I agree to voluntary participate in this study.
- I will not receive any reward for my participation.
- I have the right to withdraw from participating in this study at any time.
- My parents have to give written permission in order for me to participate, because I'm under-aged (under the age of 21 years).
- The information that I will provide will be treated as confidential and I will remain anonymous.
- The information that I have provided in the interview and by means of the evaluation may be used for the study.
- The results of the study may help the researcher to gain better understanding regarding the outcomes of cochlear implant use by late-implanted prelingually deafened adults. It will also help her to identify our specific needs.

If I have any questions or concerns, I can contact Liani van der Westhuizen at 072 298 4944 at any time.

Kind regards

Signature of participant: ____________________
Date: ____________________

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Appendix D:

Interview Schedule

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INTERVIEW SCHEDULE: The self-reported and objectively assessed outcomes of cochlear implant use for late-implanted prelingually deafened adults.

Procedure to be followed: The researcher will obtain information regarding the self-reported outcomes by means of asking the participant the following questions and indicating the participant's answer. The open-ended questions will be written down immediately.

Section A: Biographical Information
(General information & Hearing, Speech and Language History)

General information: (will be kept strictly confidential)

A1. Name:

____

A2. Surname:

____

A3. Age:

____

A4. Gender:

Male	
Female	

A5. First Language:

English	
Afrikaans	

A6.1 Occupation:

____

A6.2 Amount of communication necessary for occupation:

A lot of communication	
Moderate communication	
Very little communication	

A6.3 Number of years in present occupation:

< 1 year	
1 – 3 years	
> 3 years	

A7.1 Living circumstances after hours:

____

A7.2 Amount of communication necessary for living circumstances after hours:

A lot of communication	
Moderate communication	
Very little communication	

Information concerning your hearing history:

A8. What was the cause of your hearing loss (if known)?

____

At what age was your hearing loss identified?
A9.1 Right ear: ______________________A9.2 Left ear: ___________________________

At what age did you first use a hearing aid (if applicable)?
A10.1.1 Right ear: ____________________A10.1.2 Left ear: __________________________

A10.2 How many hours (approximately) did you use a hearing aid PRIOR TO RECEIVING YOUR COCHLEAR IMPLANT?

Never	
1 to 2 hours	
3 to 5 hours	
6 to 10 hours	
More than 10 hours per day	

A10.3 How many hours (approximately) are you currently using a hearing aid?

Never	
1 to 2 hours	
3 to 5 hours	
6 to 10 hours	
More than 10 hours per day	

Information concerning your speech and language history:

The researcher will indicate with an (X) which type of communication mode was used during the following periods:

Mainly spoken language = primary emphasis on speech-reading and speech
Mainly sign language = primary emphasis on using gestures
Mostly the same amount of spoken and sign language = both sigh language (gestures) and spoken communication.

A11.1 Before receiving your Cochlear Implant:

Mainly spoken language	
Mainly sign language	
Mostly the same amount of spoken and sign language	

A11.2 After receiving your Cochlear Implant: (currently)

Mainly spoken language	
Mainly sign language	
Mostly the same amount of spoken and sign language	

A12. What is the name of the school you attend/attended?
- during primary school: ________________
- during high school: ___________________

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Information concerning the Cochlear Implant:

The researcher will obtain this information from the participant's file and verify with the participant where needed.

A13. Do you use one or two cochlear implants?

One	
Two	

If the participant is bilaterally implanted, information for both implants will be obtained.

Date of Implantation:
A14.1 First ear: ________________________**A14.2 Second ear:** _________________________

A15. Type of cochlear implant:	**Left ear:**	**Right ear:**
CI 24 RE		
Nucleus 24 Contour Advance		
Nucleus 24 Contour		
Nucleus 24K		
Nucleus 24 Double Array		
Nucleus 24		
Freedom with Contour Advance		

Date your implant was switched on:
A16.1 First ear: ________________________**A16.2 Second ear:** ________________________

A17. Type of speech processor:	**Left ear:**	**Right ear:**
SPECTRA		
Sprint		
Esprit 22		
Esprit 24		
Esprit 3G		
Freedom		

A18. Type of speech coding strategy:	**Left ear:**	**Right ear:**
CIS		
SPEAK		
ACE		
Slow rate ACE		

A19. How many hours (approximately) do you use your implant/s each day (on the average)?

Never	
1 to 2 hours	
3 to 5 hours	
6 to 10 hours	
More than 10 hours per day	

A20. If you are using only one cochlear implant, are you currently using a hearing aid in the non-implanted ear?

Yes	
No	

A21.1 Did you receive any hearing therapy after you received the cochlear implant/s?

Yes	
No	

A21.2 If yes, how often did you receive therapy?

Less than monthly	
Monthly	
Weekly	
Twice a week	

A21.3 For what period did you receive therapy after the implantation?

Less than 3 months	
3 – 6 months	
More than 6 months	

Section B: Auditory Outcomes

1.1 Hearing:

Hearing in everyday situations:

B1.Please rate how helpful you feel the implant is in the following situations:

	Never Helpful	Sometimes Helpful	Very Helpful
B1.1 In a crowded room when you are listening to a conversation	1	2	3
B1.2 Watching TV	1	2	3
B1.3 Listening to music	1	2	3
B1.4 Listening to the radio	1	2	3
B1.5 Listening to one person	1	2	3

B2. Please rate how often you are able to recognize the following when using your cochlear implant device:

	Never	Sometimes	Always
B2.1 Telephone ringing	1	2	3
B2.2 Doorbell	1	2	3
B2.3 Someone knocking at the door	1	2	3
B2.4 Car horn	1	2	3
B2.5 Dog barking	1	2	3
B2.6 Baby crying	1	2	3

B2.7 Water running	1	2	3
B2.8 Footsteps	1	2	3
B2.9 Laughter	1	2	3
B2.10 Warning signals/police siren	1	2	3
B2.11 Car alarm	1	2	3
B2.12 Alarm clock	1	2	3

B3. Do you feel that you can hear more of the content (information) of speech presented through the cochlear implant than through your hearing aid?

Yes	
Uncertain	
No	

B4.1 Since you received your cochlear implant, to what extent are you able to understand your family and close friends on the telephone?

Not at all	
Moderately	
Very easily	

B4.2 Since you received your cochlear implant, to what extent are you able to understand strangers on the telephone?

Not at all	
Moderately	
Very easily	

Hearing at work / school / place of study:

B5. Please rate how helpful you feel the implant is in the following situation:

	Never Helpful	**Sometimes Helpful**	**Very Helpful**
B5.1 When listening to a lecturer or speaker in a lecturing hall/meeting room	1	2	3
B5.2 When receiving instructions from my supervisor/boss/lecturers	1	2	3
B5.3 When attending a meeting	1	2	3

Hearing in social situations:

B6. Please rate how helpful you feel the implant is in the following situation:

	Never Helpful	**Sometimes Helpful**	**Very Helpful**
B6.1 When you are in conversation with a small group of friends	1	2	3
B6.2 When you are listening to conversation at a	1	2	3

birthday party/party			
B6.3 When listening to conversation at a dance	1	2	3
B6.4 When you are listening to conversation in a restaurant	1	2	3
B6.5 When listening to the pastor in church	1	2	3

1.2 Speech-reading:

B7.1 How would you rate your speech-reading ability BEFORE receiving your cochlear implant?

Poor (generally unable to understand most people, even family and friends)	
Fair (difficulty understanding family and friends)	
Average (understand family and friends, difficulty understanding strangers	
Good (understand many people most of the time)	
Excellent (understand most people most of the time)	

B7.2 How would you rate your speech-reading ability AFTER receiving your cochlear implant?

Poor (generally unable to understand most people, even family and friends)	
Fair (difficulty understanding family and friends)	
Average (understand family and friends, difficulty understanding strangers	
Good (understand many people most of the time)	
Excellent (understand most people most of the time)	

B8. When you are using your cochlear implant, to what extent can you understand what one person is saying WITHOUT speech-reading, when other people are talking in the same room?

Cannot understand at all	
Can understand moderately	
Can understand very easily	

B9.1 When you are using your cochlear implant, to what extent can you understand your family and friends WITHOUT speech-reading?

Cannot understand at all	
Can understand moderately	
Can understand very easily	

B9.2 When you are using your cochlear implant, to what extent can you understand strangers WITHOUT speech-reading?

Cannot understand at all	
Can understand moderately	
Can understand very easily	

1.3 Localization:

B10.1 To what extent did your ability to determine where sounds are coming from (localize) improve, since you received your cochlear implant?

Not improved	
Moderately improved	
Much improved	

B10.2 To what extent did your ability to determine where speech is coming from (localize) improve, since you received your cochlear implant?

Not improved	
Moderately improved	
Much improved	

B11. Do you experience the day to day use of a cochlear implant as positive or negative in terms of auditory functioning? Please motivate.

____

____

Section C: Language and Communication Outcomes

In everyday situations:

C1. Are you able to make yourself understood to strangers without using gestures?

Never	
Sometimes	
Mostly	
Always	

C2. Since you received your cochlear implant, do you feel your comprehension/understanding of spoken language has improved or decreased?

Decreased	
No change	
Increased	

C3. Do you feel that the amount of words that you use (your vocabulary), since you received your cochlear implant, have increased or decreased?

Decreased	
No change	
Increased	

C4. Since you received your cochlear implant, do you feel that the complexity of sentence structures that you use has increased or decreased?

Decreased	
No change	
Increased	

Work, School, Place of study:

C5. Do you communicate effectively in a situation where you are talking with someone in the office, lecture hall or in the classroom?

Never	
Sometimes	

Mostly	
Always	

In social situations:

C6. Which of the following statements describe your communication abilities before, and then after the implant? (Tick whichever is applicable)

	Before implantation	After implantation
C6.1 Find that communication is very tiring and effortful		
C6.2 I feel at ease in company during communication		
C6.3 I can follow a conversation more easily		

C7. Since you received your cochlear implant, to what extent has your implant reduced the help needed from other people when communicating in social activities?

No reduction at all	
Moderately	
Very little help is needed now	

C8. Do you experience your communication in everyday life as positive or negative, since you received your cochlear implant? Please motivate.

____
____
____
____

<u>Section D:</u> Speech Intelligibility Outcomes

D1. Which of the following, if any, do you feel characterises your speech before, and then after your implantation? (Tick whichever is applicable)

	Before Implantation	After Implantation
Too soft		
Too slow		
Too loud		
Too fast		
More controlled		

D2. Since you received your cochlear implant, to what extent can you control the sound of your own voice?

Cannot control it	
Moderately able to control it	
Can control it very easily	

D3. Since you received your cochlear implant, how do you feel that other people experience your pronunciation of words?

Much poorer	
Poor	
No change	
Better	
Much better	

D4. Since you received your cochlear implant, how do you feel that other people experience your overall speech intelligibility?

More unintelligible	
No change	
More intelligible	
Highly intelligible	

D5. Do you experience that the quality of your speech intelligibility has improved, since you received your cochlear implant? Please motivate?

____
____
____
____

<u>Section E:</u> Quality of Life Outcomes

Quality of life in everyday situations:

E1. Since you received your cochlear implant, to what extent has your daily life (for example your daily routine, daily activities, daily chores) become easier and less effortful?

Much easier	
Mildly easier	
No change	

E2. Since you received your cochlear implant, do you feel more or less independent?

Less independent	
No change	
More independent	

E3.1 Has there been a change in your relationships with any of your family members since the implant?

Yes	
No	

E3.2 If yes, please elaborate:

____

____
____

E4. Did the implant have any impact on your relationship with your partner (e.g. did it bring you closer, increase tension and misunderstanding or was there no change)?

____
____
____

E5.1 How would you evaluate the quality of your relationships with your deaf friends since you received your implant?

Relationships have improved	
Remained the same	
Relationships have deteriorated	

E5.2 How would you evaluate the quality of your relationships with your hearing friends since you received your implant?

Relationships have improved	
Remained the same	
Relationships have deteriorated	

Quality of life at work / school / place of studies:

E6. How would you evaluate the quality of your relationships with your co-workers/ teachers/lecturers since the implant?

Less satisfying	
The same as before	
More satisfying	

E7. How satisfying is your employment/studies since the implant?

Less satisfying	
The same as before	
More satisfying	
Not applicable	

E8. How do you think your cochlear implant affects your performance (the action or process of performing a work task or specific function that is expected from you) at work/ school/ university/college/technikon?

Negatively	
No effect	
Positively	

Quality of life in social situations:

E9. Which of the following statements describes your experiences since you received your cochlear implant? (Tick whichever is applicable)

E9.1 I feel less lonely since my implant	
E9.2 I don't avoid social contact so often since I got an implant	
E9.3 I am less embarrassed when I wear/use my cochlear implant in	

company	
E9.4 I feel less isolated since I got the implant	

E10.1 To what extent has the number of social activities you attend changed since you received the implant?

Greatly Increased	
Slightly increased	
Stayed the same	
Slightly decreased	
Greatly decreased	

E10.2 How comfortable are you now, using your cochlear implant, when attending social events?

Very comfortable	
Moderately comfortable	
Not comfortable	

E11. Since you received your cochlear implant, to what extent has your self-confidence increased?

No increase at all	
Moderate increase	
A great increase	

E12. Since you received your cochlear implant, to what extent has your self-consciousness changed?

More self-conscious	
No change	
Less self-conscious	

E13. Do you experience the use of a cochlear implant positive or negative in terms of your quality of life? Please motivate.

____
____
____

ONDERHOUD SKEDULE: Die self-gerapporteerde en objektief geëvalueerde uitkomste van kogleêre inplanting gebruik deur laat-geïnplanteerde prelinguale dowe volwassenes.

Prosedure wat gevolg sal word: Die navorser sal inligting aangaande die self-gerapporteerde uitkomste verkry deur die volgende vrae aan die deelnemer te rig en die deelnemer se antwoorde aan te dui met 'n kruisie. Die oop einde vrae sal dadelik neergeskryf word.

Afdeling A: Biografiese Inligting
(Algemene inligting & Gehoor, Taal en Spraak Geskiedenis).

Algemene inligting: (sal vertroulik hanteer word)

A1. Naam: ____

A2. Van: ____

A3. Ouderdom: ____

A4. Geslag:

Manlik	
Vroulik	

A5. Voorkeur taal:

Afrikaans	
Engels	

A6.1 Beroep: ____

A6.2 Hoeveelheid kommunikasie benodig vir beroep:

Baie kommunikasie	
Gemiddelde hoeveelheid kommunikasie	
Baie min kommunikasie	

A6.3 Hoeveelheid jare in huidige beroep:

< 1 jaar	
1 – 3 jare	
> 3 years	

A7.1 Leef omstandighede na ure:

____

A7.2 Hoeveelheid kommunikasie benodig vir leef omstandighede na ure:

Baie kommunikasie	
Gemiddelde hoeveelheid kommunikasie	
Baie min kommunikasie	

Inligting aangaande u gehoor geskiedenis:

A8. Wat was die oorsaak van u gehoorverlies (indien bekend)?

____

Op watter ouderdom is u gehoorverlies geïdentifiseer?
A9.1Regteroor: ______________________A9.2Linkeroor: _________________________

Op watter ouderdom het u die eerste keer 'n gehoorapparaat gebruik(indien toepaslik)?
A10.1.1 Regteroor: ___________________A10.1.2 Linkeroor: ________________________

A10.2 Hoeveel ure (ongeveer) het u die gehoorapparaat gebruik VOORDAT U DIE KOGLEÊRE INPLANTING ONTVANG HET?

Nooit	
1 tot 2 ure	
3 tot 5 ure	
6 tot 10 ure	
Meer as 10 ure per dag	

A10.3 Hoeveel ure (ongeveer) gebruik u tans die gehoorapparaat?

Nooit	
1 tot 2 ure	
3 tot 5 ure	
6 tot 10 ure	
Meer as 10 ure per dag	

Inligting aangaande u spraak en taal geskiedenis:

Die navorser sal aandui watter tipe kommunikasie wyse gebruik is tydens die volgende periodes deur middel van 'n kruisie (X):

Hoofsaaklik gesproke taal = Primêre klem is op die gebruik van liplees vaardighede en spraak
Hoofsaaklik gebaretaal = Primêre klem op die gebruik van gebaretaal
Meestal gelyke hoeveelheid gesproke- en gebaretaal = Beide gebaretaal en gesproke taal word gebruik

A11.1 Voordat u die kogleêre inplanting ontvang het

Hoofsaaklik gesproke taal	
Hoofsaaklik gebaretaal	
Meestal gelyke hoeveelheid gesproke- en gebaretaal	

A11.2 Nadat u die kogleêre inplanting ontvang het: (tans)

Hoofsaaklik gesproke taal	
Hoofsaaklik gebaretaal	
Meestal gelyke hoeveelheid gesproke- en gebaretaal	

A12.1 Watter tipe skool het u tydens laerskool bygewoon?

Spesiale skool: Staat	
Spesiale skool: Privaat	
Hoofstroom skool: Staat	

Hoofstroom skool: Privaat	
Tuis onderrig	

A12.2 Spesifiseer die naam van die laerskool:

____

A12.3 Watter tipe skool het u tydens hoërskool bygewoon?

Spesiale skool: Staat	
Spesiale skool: Privaat	
Hoofstroom skool: Staat	
Hoofstroom skool: Privaat	
Tuis onderrig	

A12.4 Spesifiseer die naam van die hoërskool:

____

Inligting aangaande die Kogleêre Inplanting:

Die navorser sal die volgende inligting verkry vanuit die deelnemer se leêr en sal geverifieër word met die deelnemer indien dit nodig is.

A13. Maak u tans gebruik van een of twee kogleêre inplantings?

Een	
Twee	

Indien die deelnemer bilateraal geïnplanteer is, sal inligting rakende beide inplantings gedokumenteer word.

Ouderdom waarop inplanting ontvang is?
A14.1 Eerste oor: _______________________ **A14.2 Tweede oor:** _______________________

Datum van inplantering:
A15.1 Eerste oor: ________________________**A15.2 Tweede oor:** _______________________

A16. Tipe kogleêre inplanting:	**Linkeroor:**	**Regteroor:**
CI 24 RE		
Nucleus 24 Contour Advance		
Nucleus 24 Contour		
Nucleus 24K		
Nucleus 24 Double Array		
Nucleus 24		
Freedom met Contour Advance		

Datum van die aanskakeling van u inplanting:
A17.1 Eerste oor: _______________________**A17.2 Tweede oor:** _______________________

A18. Tipe spraakprosesseerder:

	Linkeroor:	Regteroor:
SPECTRA		
Sprint		
Esprit 22		
Esprit 24		
Esprit 3G		
Freedom		

A19. Tipe spraakkoderingstrategie:

	Linkeroor:	Regteroor:
CIS		
SPEAK		
ACE		
Stadige tempo ACE		

A20. Hoeveel ure (ongeveer) gebruik u die kogleêre inplanting/s daagliks (gemiddeld)?

Nooit	
1 tot 2 ure	
3 tot 5 ure	
6 tot 10 ure	
Meer as 10 ure per dag	

A21. Indien u net een kogleêre inplanting gebruik, maak u gebruik van 'n gehoorapparaat in die nie-geïnplanteerde oor?

Ja	
Nee	

A22.1 Het u enige gehoorterapie ontvang nadat u die inplanting ontvang het?

Ja	
Nee	

A22.2 Indien u antwoord ja is, hoe gereeld het u terapie ontvang?

Minder as maandeliks	
Maandeliks	
Weekliks	
Twee maal per week	

A22.3 Vir watter periode het u terapie ontvang na die inplanting?

Minder as 3 maande	
3 – 6 maande	
Meer as 6 maande	

<u>Afdeling B</u>: Ouditiewe Uitkomste

1.1 ***Gehoor:***

Gehoor in elkedaagse situasies:

B1. Dui asseblief u beoordeling aan aangaande die nuttigheid van u kogleêre inplanting in die volgende situasies:

	Nooit Nuttig	Somtyds Nuttig	Baie Nuttig
B1.1 In 'n besige kamer, wanneer u na 'n gesprek luister	1	2	3
B1.2 In kleiner groepe mense (2-5), wanneer u na 'n gesprek luister	1	2	3
B1.3 Terwyl u na die televisie luister	1	2	3
B1.4 Wanneer u na musiek luister	1	2	3
B1.5 Wanneer U na die radio luister	1	2	3
B1.6 Wanneer u luister na persoon	1	2	3

B2. Dui asseblief u beoordeling aan aangaande u vermoë om die volgende te herken met die gebruik van die kogleêre inplanting:

	Nooit	Somtyds	Altyd
B2.1 Lui van 'n telefoon	1	2	3
B2.2 Deurklokkie	1	2	3
B2.3 Iemand wat aan die deur klop	1	2	3
B2.4 Kar toeter	1	2	3
B2.5 Honde wat blaf	1	2	3
B2.6 Baba wat huil	1	2	3
B2.7 Water wat loop	1	2	3
B2.8 Voetstappe	1	2	3
B2.9 Mense wat lag	1	2	3
B2.10 Waarskuwingseine/polisie sirene	1	2	3
B2.11 Kar alarm	1	2	3
B2.12 Wekker	1	2	3

B3. Voel u of dat u meer van die inhoud (inligting) van spraak kan hoor deur die gebruik van u kogleêre inplanting as deur 'n gehoorapparaat?

Ja	
Onseker	
Nee	

B4.1 Vandat u die kogleêre inplanting ontvang het, tot watter mate is u instaat om u familie en naby vriende te verstaan, as u met hulle oor die telefoon praat?

Glad nie instaat nie	
Gemiddeld instaat	
Baie maklik instaat	

B4.2 Vandat u die kogleêre inplanting ontvang het, tot watter mate is u instaat om vreemdelinge oor die telefoon te verstaan?

Glad nie instaat nie	
Gemiddeld instaat	

Baie maklik instaat	

Gehoor by die werk/skool/plek van studies:

B5. Dui asseblief u beoordeling aan aangaande die nuttigheid van u kogleêre inplanting in die volgende situasies:

	Nooit Nuttig	Somtyds Nuttig	Baie Nuttig
B5.1 Wanneer u na 'n spreker of dosent luister in 'n lesingsaal/vergadering kamer	1	2	3
B5.2 Wanneer u instruksies ontvang van u toesighouer/werkgewer/dosente	1	2	3
B5.3 Wanneer u 'n vergadering bywoon	1	2	3

Gehoor in sosiale situasies:

B6. Dui asseblief u beoordeling aan aangaande die nuttigheid van u kogleêre inplanting in die volgende situasies:

	Nooit Nuttig	Somtyds Nuttig	Baie Nuttig
B6.1 Wanneer u in gesprek is met 'n klein groepie vriende	1	2	3
B6.2 Wanneer u luister na 'n gesprek by 'n verjaarsdag partytjie/partytjie	1	2	3
B6.3 Wanneer u luister na 'n gesprek by 'n dans	1	2	3
B6.4 Wanneer u luister na 'n gesprek in 'n restaurant	1	2	3
B6.5 Wanneer u luister na 'n dominee in die kerk	1	2	3

<u>1.2. Liplees:</u>

B7.1 Hoe sal u u liplees vaardigheid beoordeel VOORDAT u die kogleêre inplanting ontvang het?

Swak (is oor die algemeen nie instaat om die meeste mense te verstaan nie, selfs familie en vriende)	
Taamlik swak (ervaar probleme om vriende en familie te verstaan)	
Gemiddeld (verstaan familie en vriende, maar ervaar probleme met die verstaan van vreemdelinge)	
Goed (verstaan baie mense die meeste van die tyd)	
Uitstekend (verstaan die meeste mense die meeste van die tyd)	

B7.2Hoe sal u u liplees vaardigheid beoordeel NADAT u die kogleêre inplanting ontvang het?

Swak (is oor die algemeen nie instaat om die meeste mense te verstaan nie, selfs familie en vriende)	
Taamlik swak (ervaar probleme om vriende en familie te verstaan)	
Gemiddeld (verstaan familie en vriende, maar ervaar probleme met die verstaan van vreemdelinge)	
Goed (verstaan baie mense die meeste van die tyd)	
Uitstekend (verstaan die meeste mense die meeste van die tyd)	

B8. Wanneer u die kogleêre inplanting gebruik, tot watter mate kan u verstaan wat een persoon sê SONDER om te liplees, veral as ander persone in dieselfde kamer praat?

Kan glad nie verstaan nie	
Kan redelik verstaan	
Kan baie maklik verstaan	

B9.1 Wanneer u die kogleêre inplanting gebruik, tot watter mate kan u u familie en vriende verstaan, SONDER om te liplees?

Kan glad nie verstaan nie	
Kan redelik verstaan	
Kan baie maklik verstaan	

B9.2 Wanneer u die kogleêre inplanting gebruik, tot watter mate kan u vreemdelinge verstaan SONDER om te liplees?

Kan glad nie verstaan nie	
Kan redelik verstaan	
Kan baie maklik verstaan	

1.3. Lokalisasie:

B10.1 Tot watter mate het u vermoë om die rigting waarvandaan klank kom (lokaliseer), te lokaliseer, vandat u die kogleêre inplanting ontvang het?

Glad nie verbeter	
Redelik verbeter	
BBaie verbeter	

B10.2 Tot watter mate is het u vermoë om die rigting waarvandaan spraak kom (lokaliseer), te lokaliseer, vandat u die kogleêre inplanting ontvang het?

Glad nie verbeter	
Redelik verbeter	
Baie verbeter	

B11. Ervaar u die dag-tot-dag gebruik van 'n kogleêre inplanting as positief of negatief in terme van ouditiewe funksionering? Motiveer asseblief.

____

____

Afdeling C: Taal en Kommunikasie Uitkomste

In elkedaagse situasies:

C1. Is u instaat om uself uit te druk, sonder die gebruik van gebare, sodat vreemdelinge u sal verstaan, nadat u die kogleêre implanting ontvang het?

Nooit	
Somtyds	
Meestal	
Altyd	

C2. Vandat u die kogleêre inplanting ontvang het, voel u dat u begrip/verstaan van gesproke taal verbeter of verminder het?

Verminder	
Geen verandering	
Verbeter	

C3. Voel u dat die hoeveelheid woorde wat u gebruik (u woordeskat) vermeerder of verminder het, vandat u die kogleêre inplanting ontvang het?

Verminder	
Geen verandering	
Vermeerder	

C4. Vandat u die kogleêre inplanting ontvang het, voel u dat die kompleksiteit van sinstrukture(langer sinne) wat u gebruik, verbeter of verswak het?

Verswak	
Geen verandering	
Verbeter	

Werk, skool, plek van studies:

C5. Kommunikeer u effektief in 'n situasie waar u met iemand moet praat in die kantoor, lesingsaal of in die klaskamer?

Nooit	
Somtyds	
Meestal	
Altyd	

In sosiale sitausies:

C6. Watter van die volgende stellings beskryf u kommunikasie vaardighede voor, en dan na die inplanting? (merk wat toepaslik is)

	Voor die inplanting	**Na die inplanting**
C6.1 Ervaar dat kommunikasie baie uitputtend is		
C6.2 Ek voel op my gemak tydens 'n kommunikasie situasie		
C6.3 Ek kan gemaklik 'n gesprek volg		

C7. Vandat u die kogleêre inplanting ontvang het, tot watter mate het u inplanting die hoeveelheid hulp van ander benodig, verminder tydens 'n kommunikasie situasie?

Geen vermindering nie	
Redelike vermindering	
Geen hulp word benodig nie	

C8. Ervaar u u kommunikasie in daaglikse lewe as positief of negatief, vandat u die kogleêre inplanting ontvang het? Motiveer asseblief.

____

____

<u>Afdeling D:</u> Spraak Verstaanbaarheid Uitkomste

D1. Watter van die volgende, indien enige, voel u beskryf u spraak voor en dan nadat u die kogleêre inplanting ontvang het? (merk watter toepaslik is)

	Voor die inplanting	**Na die inplanting**
Te sag		
Te stadig		
Te hard		
Te vinnig		
Meer beheers: in terme van volume en spoed		

D2. Vandat u die kogleêre inplanting ontvang het, tot watter mate is u instaat om die klank van u eie stem te beheer?

Kan dit nie beheer nie	
Redelik instaat om dit te beheer	
Kan dit baie maklik beheer	

D3. Vandat u die kogleêre inplanting ontvang het, hoe voel u ander persone ervaar u uitspraak van woorde?

Baie swakker	
Swak	
Geen verandering	
Beter	
Baie beter	

D4. Vandat u die kogleêre inplanting ontvang het, hoe voel u ervaar ander persone u algemene spraak verstaanbaarheid?

Meer onverstaanbaar	
Geen verandering	
Meer verstaanbaar	
Hoogs verstaanbaar	

D5. Ervaar u dat die kwaliteit van u spraak verbeter het, vandat u die kogleêre inplanting ontvang het? Motiveer asseblief.

____

____

Afdeling E: Lewenskwaliteit Uitkomste

Lewenskwaliteit in elkedaagse situasies:

E1. Vandat u die kogleêre inplanting ontvang het, tot watter mate het u daaglikse lewe (bv. u daaglikse roetines, daaglikse aktiwiteite en daaglikse pligte) makliker en minder uitdagend geword?

Baie makliker	
Redelik makliker	
Geen verandering	
Meer uitdagend	

E2. Vandat u die kogleêre inplanting ontvang het, voel u meer of minder onafhanklik?

Minder onafhanklik	
Geen verandering	
Meer onafhanklik	

E3.1 Is daar enige verandering in u verhoudings met ander van u familielede, vandat u die inplanting ontvang het?

Ja	
Nee	

E3.2 Indien ja, brei asseblief uit:

____
____

E4. Het die inplanting enige impak gehad op u verhouding met u eggenoot of naasbestaande (het dit u nader gebring aan mekaar, spanning verhoog en misverstande vermeerder of was daar geen verandering?

____
____
____

E5.1 Hoe sal u die kwaliteit van u verhoudings met u dowe vriende evalueer, vandat u die kogleêre inplanting verkry het?

Verhoudings het verbeter	
Verhoudings het dieselfde gebly	
Verhoudings het agteruit gegaan	

E5.2 Hoe sal u die kwaliteit van u verhoudings met u horende vriende evalueer, vandat u die kogleêre inplanting verkry het?

Verhoudings het verbeter	
Verhoudings het dieselfde gebly	
Verhoudings het agteruit gegaan	

Lewenskwaliteit by die werk/skool/plek van studies:

E6. Hoe sal u die kwaliteit van u verhoudings met u mede-werkers/onderwysers/dosente evalueer, vandat u die inplanting ontvang het?

Minder bevredigend	
Dieselfde as voorheen	
Meer bevredigend	

E7. Hoe bevredigend is u werk vandat u die kogleêre inplanting ontvang het?

Minder bevredigend	
Dieselfde as voorheen	
Meer bevredigend	
Nie van toepassing	

E8. Hoe dink u affekteer u kogleêre inplanting u prestasie (die fisiese aksie of proses van die uitvoering van u werkstake of spesifieke funksies wat van u verwag word) by die werk/skool/universiteit/kollege/tegnikon?

Negatief	
Geen effek	
Positief	

Lewenskwaliteit in sosiale situasies:

E9. Watter van die volgende stellings beskryf u ervarings vandat u die kogleêre inplanting ontvang het? (Merk wat toepaslik is)

E9.1 Ek voel minder alleen vandat ek my kogleêre inplanting het	
E9.2 Ek vermy nie meer sosiale kontak vandat ek my inplanting gekry het nie	
E9.3 Ek kry minder skaam wanneer ek my inplanting gebruik/dra in ander mense se geselskap	
E9.4 Ek voel minder alleen vandat ek my inplanting gekry het	

E10.1 Tot watter mate het die hoeveelheid van sosiale aktiwiteite wat u bywoon, maandeliks verander vandat u die inplanting ontvang het?

Baie vermeerder	
Effens vermeerder	
Dieselfde gebly	
Effens verminder	
Baie verminder	

E10.2 Hoe gemaklik is u tans, met die gebruik van die inplanting, om sosiale geleenthede by te woon?

Baie gemaklik	
Redelik gemaklik	
Glad nie gemaklik	

E11. Vandat u die kogleêre inplanting ontvang het, tot watter mate het u selfvertroue (in jouself glo) verbeter?

Geen verbetering nie	
Gemiddelde verbetering	

‘n Groot verbetering	

E12. Vandat u die kogleêre inplanting ontvang het, tot watter mate het u selfbewustheid (voel ongemaklik en in verleentheid) verander?

Meer selfbewus	
Geen verandering	
Minder selfbewus	

E13. Ervaar u die gebruik van die kogleêre inplanting positief of negatief in terme van u lewenskwaliteit? Motiveer asseblief.

____
____
____

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Appendix E:

Objective Test Battery

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Universiteit van Pretoria / University of Pretoria
Kommunikasiepatologie / Communication Pathology

Tel: (012) 420-2816 / (012) 420-2491

Naam / Name: ____________________ Datum / Date: ____________________

GEB / DOB: ____________ Oudioloog / Audiologist: ____________ Student / Student: ____________

Suiwertoonoudiogram / Pure Tone Audiogram

Regteroor / Right Ear

dB	125	250	500	1000	2000	4000	8000
0							
10							
20		NORMAL					
30							
40		MILD					
50							
60		MODERATE					
70							
80		SEVERE					
90							
100							
110		PROFOUND					
120							
130							

Maskering / Masking

LG/AC							
BG/BC							

Linkeroor / Left Ear

dB	125	250	500	1000	2000	4000	8000
0							
10							
20		NORMAL					
30							
40		MILD					
50							
60		MODERATE					
70							
80		SEVERE					
90							
100							
110		PROFOUND					
120							
130							

Maskering / Masking

LG/AC							
BG/BC							

% Gehoorverlies:
% Hearing Loss: R ________ L ________ B ________

Weber

250	500	1000	2000	4000

Rinne

R	L

Otoskopiese Ondersoek / Otoscopic Examination

R	
L	

Spraakoudiogram / Speech Audiogram

%	10	20	30	40	50	60	70	80	90	100
100										
90										
80										
70										
60										
50										
40										
30										
20										
10										
0										

Maskering L										
Masking R										

	R	L
STD / PTA		
SOD / SRT		
Disk % Disc.		
MGL / MCL VP / UCL		
Spraakdeteksie Speech Detection		

Akoestiese Immittansie / Acoustic Immittance

	R	L
Timpanogram /Tympanogram		
Middeloordruk / Middle Ear Pressure		
Statiese / Static Compliance		
Oorkanaal Volume / Ear Canal Volume		

Akoestiese Refleks / Acoustic Reflex

Refleks Drempel Reflex Threshold: R Kontra Contra	Refleks Drempel Reflex Threshold: R Ipsi	PTT / STD	Verskil Difference	Refleks Verswering Reflex Decay	Frekwensie Frequency	Refleks Drempel Reflex Threshold: L Kontra Contra	Refleks Drempel Reflex Threshold: L Ipsi	PTT / STD	Verskil Difference	Refleks Verswering Reflex Decay
					250 Hz					
					500 Hz					
					1 kHz					
					2 kHz					
					4 kHz					

	Ongemaskeerde lug Unmasked Air	Ongemaskeerde Been Unmasked Bone	Gemaskeerde Lug Unmasked Air	Gemaskeerde Been Masked Bone	Geen Respons No Response	Vrye Veld Sound Field	VP / UCL
R	○	<	△	⊏	↓	S	⊓
L	X	>	□	⊐			

AFRIKAANS FONETIES GEBALANSEERDE WOORDELYS

	LYS 1		LYS 2		LYS 3		LYS 4	
	vlieg	brief	brood	vryf	een	vlag	brug	vroeg
	brand	eers	oop	praat	vriend	iets	eet	bril
	om	fraai	vroeg	vars	volg	vrag	vel	aand
	diens	vloer	volk	beurt	blou	bruin	vlam	vleis
	klomp	drink	blink	dier	broer	droog	breek	draai
	vra	drop	droom	klaar	deur	dank	diep	klaar
	koel	kraal	klein	druk	klam	klink	krap	dink
	lof	kleur	kry	leer	lyf	les	loop	kort
	langs	lig	lag	krag	kloof	klim	klop	leun
	hy	spring	lief	snaaks	vaal	lank	lag	lomp
	staan	lei	sterf	los	skerp	skrif	swart	stert
	spuit	stoom	stil	hang	groen	skoon	spreek	hoof
	rak	haar	heel	hand	seep	hok	huis	self
	hulp	reën	huil	noem	haal	rok	hof	hark
	weet	hart	roep	streep	hier	half	roem	res
	reël	ruk	reg	traan	rug	ram	ring	woon
	moet	woes	res	rond	raak	wat	wiel	rant
	werd	weg	mond	mark	wol	merk	meer	werk
	neef	maat	nou	grap	maand	tong	wa	mos
	maan	jonk	teen	trok	was	perd	nog	my
	gras	neus	pos	ja	moes	prys	jaar	niks
	trap	groot	pluk	reus	tree	teer	plaas	peer
	tog	trek	groei	wen	plaat	jy	trou	plank
	plek	plan	weef	wind	nes	nee	groet	graf
	berg	paar	waar	erg	prop	golf	treur	trein
Pers. woorde korrek								
Links (L) of Regs (R)								
Vrye veld (VV)								
Oudiometer intensiteit								
Tipe Gehoor-apparaat								
+ Spraaklees - Spraaklees								

TYGERBERG HOSPITAAL

CID SINNE AFRIKAANSE VERTALING

NAAM: ____________________ DATUM: ____________

__________ PRE INPLANT dB (KDP) __________

__________ MND. EVALUASIE TOTAAL __________/50

LYS B

1.	Die water is te koud om in te swem	(5)	( )
2.	Waarom moet ek so vroeg in die more opstaan?	(7)	( )
3.	Hier is jou skoene.	(3)	( )
4.	Dit reën.	(2)	( )
5.	Waarheen gaan jy?	(3)	( )
6.	Kom hier as ek jou roep!	(3)	( )
7.	Moenie weer probeer om daarmee weg te kom nie!	(6)	( )
8.	Behoort ons klein kindertjies alleen te laat gaan fliek?	(9)	( )
9.	Daar's nie genoeg verf om die kamer klaar te maak nie.	(8)	( )
10.	Wil jy 'n eier he vir ontbyt.	(4)	( )
	TOTAAL	(50)	( )

[TBH 4]

TYGERBERG HOSPITAAL

CID SINNE AFRIKAANSE VERTALING

NAAM: ______________________ DATUM: ____________

__________ PRE INPLANT dB (KDP) __________

__________ MND. EVALUASIE TOTAAL __________/50

LYS B

1.	Die water is te koud om in te swem	(5)	( )
2.	Waarom moet ek so vroeg in die more opstaan?	(7)	( )
3.	Hier is jou skoene.	(3)	( )
4.	Dit reën.	(2)	( )
5.	Waarheen gaan jy?	(3)	( )
6.	Kom hier as ek jou roep!	(3)	( )
7.	Moenie weer probeer om daarmee weg te kom nie!	(6)	( )
8.	Behoort ons klein kindertjies alleen te laat gaan fliek?	(9)	( )
9.	Daar's nie genoeg verf om die kamer klaar te maak nie.	(8)	( )
10.	Wil jy 'n eier he vir ontbyt.	(4)	( )
	TOTAAL	(50)	( )

[TBH 4]

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

TYGERBERG HOSPITAAL

CID SINNE AFRIKAANSE VERTALING

NAAM: ______________________ DATUM: ____________

__________ PRE INPLANT dB (KDP) ____________

__________ MND. EVALUASIE TOTAAL ________/50

LYS E

1.	Jy kan die bus oorkant die straat haal.	[6]	[ ]
2.	Bel haar en vertel haar die nuus.	[5]	[ ]
3.	Ek kry jou later.	[4]	[ ]
4.	Ek sal daaroor dink.	[4]	[ ]
5.	Ek wil nie vanaand gaan fliek nie.	[6]	[ ]
6.	As jou tand so seer is, behoort jy 'n tandarts te gaan spreek.	[9]	[ ]
7.	Sit die koekie terug in die blik.	[5]	[ ]
8.	Hou op om gek te skeer.	[4]	[ ]
9.	Die tyd is verstreke.	[3]	[ ]
10.	Hoe spel jy jou naam?	[4]	[ ]
	TOTAAL	[50]	[ ]

[TBH7]

TYGERBERG HOSPITAAL

CID SINNE AFRIKAANSE VERTALING

NAAM: ______________________ DATUM: ____________

__________ PRE INPLANT dB (KDP) __________

__________ MND. EVALUASIE TOTAAL __________/50

LYS D

1.	Dis tyd om te gaan	(3)	( )
2.	As jy nie hierdie tydskrifte wil he nie, moet jy hulle weggooi.	(7)	( )
3.	Wil jy jou hande was?	(3)	( )
4.	Dis regtig donker vanaand, ry dus versigtig.	(5)	( )
5.	Ek sal die pakkie vir jou dra.	(5)	( )
6.	Het jy vergeet om die kraan toe te draai?	(5)	( )
7.	Visvang in 'n bergstroom is my idee van plesier.	(6)	( )
8.	Vaders spandeer nou meer tyd met hulle kinders as in die verlede.	(8)	( )
9.	Wees versigtig om nie jou bril te breek nie.	(6)	( )
10.	Ek's jammer.	(2)	( )
	TOTAAAL	(50)	( )

[TBH 6]

Katalogusnommer: 3411/2

AFRIKAANSE RESEPTIEWE WOORDESKATTOETS (ARW)

ANTWOORDBLAD

VORM B

IDENTIFISERENDE BESONDERHEDE

Naam ______	Verwysingsno. ______
Skool ______	Huistaal ______
Standerd ______ Klas ______	Geslag ______

DATUM EN CHRONOLOGIESE OUDERDOM

	Jaar	Maand	Dag
Toetsdatum			
Geboortedatum			
Chronologiese ouderdom			*
Chronologiese ouderdom afgerond			

* Indien die aantal dae 15 oorskry rond af na die volgende maand

TOETSRESULTATE

BEREKENING VAN ROUPUNT

Plafonitem ______

Minus foute ______

Roupunt ______

(Tel slegs foute tussen die hoogste basis en die laagste plafon)

NORMS EN HALFVERTROUENSINTERVALLENGTE

Ouderdomsekwivalent ______

Standaardtellingekwivalent ______

Halfvertrouensintervallengte vir 'n 95% vertrouenspeil. ______
(Kyk in handleiding vir tabel met halfvertrouensintervallengtes).

VERTROUENSINTERVAL VIR DIE WARE TELLING

Dui die verkreë standaardtellingekwivalent aan met 'n vertikale lyn (|), en die interval waarbinne die ware telling verwag kan word om 95 uit 100 keer te val, met hakies bv. [ ].

50 60 70 80 90 100 110 120 130 140

OPMERKINGS

....

....

....

TOETSAFNEMER ______

SENTRUM ______

GROEP: ONDERWYS

OEFENWOORDE

	A			B		
1:	kous	(2)	___	eend	(3)	___
2:	bottel	(4)	___	potlood	(1)	___
3:	hand	(1)	___	druiwe	(2)	___
4:	aap	(3)	___	kers	(4)	___

Toetswoord		Respons	R/V
1.	kat	N (4)	
2.	bal	N (1)	
3.	perd	N (4)	
4.	blom	N (1)	
5.	vliegtuig	N (4)	
6.	telefoon	N (1)	
7.	appel	N (3)	
8.	blokkie	N (4)	
9.	vurk	N (2)	
10.	horlosie	N (3)	
11.	slang	N (1)	
12.	blaar	N (1)	
13.	swem	W (4)	
14.	trein	N (2)	
15.	handsak	N (1)	
16.	koppie	N (3)	
17.	skoenlapper	N (2)	
18.	doek	N (3)	
19.	dans	W (4)	
20.	koerant	N (3)	
21.	soen	W (1)	
22.	byt	W (4)	
23.	gaap	W (1)	
24.	helikopter	N (3)	
25.	pappa	N (2)	
26.	maan	N (3)	
27.	garing	N (1)	
28.	baie	A (2)	
29.	robot	N (4)	
30.	by	N (2)	

	Toetswoord		Respons	R/V
	31.	op	V (3)	
5j.	32.	duim	N (4)	
	33.	feëtjie	N (2)	
	34.	skeer	W (1)	
	35.	knipmes	N (3)	
	36.	betaal	W (2)	
	37.	jaag	W (1)	
	38.	mou	N (3)	
	39.	gee	W (1)	
	40.	onder	V (2)	
	41.	pos	W (1)	
	42.	skil	W (3)	
	43.	apteek	N (2)	
	44.	tennis	N (1)	
	45.	lank	A (3)	
	46.	driehoek	N (2)	
	47.	gly	W (3)	
	48.	ken	N (2)	
6j.	49.	nar	N (3)	
	50.	kraai	W (1)	
	51.	leeg	A (3)	
	52.	fluister	W (4)	
	53.	gloeilamp	N (3)	
	54.	susters	N (2)	
	55.	slurp	N (1)	
	56.	wys	W (3)	
	57.	voer	W (1)	
	58.	voor	V (4)	
	59.	koevert	N (3)	
	60.	brandstof	N (2)	

	Toetswoord		Respons	R/V
	61.	kruip	W (1)	
	62.	glimlag	W (3)	
	63.	sweep	N (1)	
	64.	dolfyn	N (2)	
	65.	volstruis	N (1)	
	66.	trompet	N (4)	
	67.	skeur	W (2)	
	68.	skerm	W (1)	
7j.	69.	stewel	N (2)	
	70.	skaam	A (1)	
	71.	stad	N (4)	
	72.	onderwyseres	N (3)	
	73.	verlam	A (2)	
	74.	liefkoos	W (4)	
	75.	rekenaar	N (1)	
	76.	fluks	A (2)	
	77.	album	N (3)	
	78.	tussen	V (2)	
	79.	patrollie	N (3)	
	80.	ontvang	W (4)	
	81.	klou	N (2)	
	82.	ontploffing	N (3)	
8j.	83.	gesin	N (3)	
	84.	aanval	W (2)	
	85.	uniform	N (3)	
	86.	gekraak	A (4)	
	87.	web	N (3)	
	88.	esel	N (1)	
	89.	varing	N (2)	
	90.	uitgestrek	A (1)	

OEFENWOORDE

C			D		
1: voël	(4)	___	mens	(1)	___
2: padda	(2)	___	plant	(3)	___
3: skilpad	(3)	___	dier	(4)	___
4: krokodil	(1)	___	vrug	(2)	___

Toetswoord	Respons	R/V
91. kluis	N (3)	
92. groente	N (4)	
93. leerling	N (2)	
94. pawiljoen	N (3)	
95. bewaak	W (2)	
96. verras	W (4)	
97. korrel	W (2)	
98. mikroskoop	N (3)	
99. sertifikaat	N (2)	
100. syfer	N (2)	
101. fakkel	N (2)	
102. skoorsoek	W (3)	
103. kruik	N (2)	
104. kruier	N (3)	
105. arresteer	W (4)	
106. moesie	N (3)	
107. ruiter	N (4)	
108. geut	N (3)	
109. grimeersel	N (4)	
110. almanak	N (1)	
111. hoefyster	N (3)	
112. bagasie	N (1)	
113. armoedig	A (2)	
114. prooi	N (4)	
115. piramide	N (3)	
116. ontkiem	W (1)	
117. skag	N (2)	
118. oorgewig	A (1)	
119. waaghalsig	A (3)	
120. wimpers	N (4)	

11].

12].

Toetswoord	Respons	R/V
121. welpie	N (3)	
122. blus	W (3)	
123. kelner	N (2)	
124. suiwel	N (3)	
125. bestanddele	N (4)	
126. argumenteer	W (4)	
127. peul	N (1)	
128. insek	N (3)	
129. korf	N (1)	
130. profeet	N (2)	
131. silinder	N (3)	
132. hengel	W (2)	
133. verdrietig	A (1)	
134. betoog	W (4)	
135. boemerang	N (1)	
136. manel	N (3)	
137. jeugdig	A (3)	
138. geskub	A (4)	
139. argitek	N (4)	
140. bejaard	A (2)	
141. vergesel	W (3)	
142. kanaal	N (2)	
143. obstruksie	N (1)	
144. prieel	N (2)	
145. kweek	W (3)	
146. vulkaan	N (2)	
147. populêr	A (3)	
148. konstruksie	N (2)	
149. skeikundige	N (1)	
150. besoedeld	A (1)	

Toetswoord	Respons	R/V
151. geriffeld	A (4)	
152. larwe	N (1)	
153. bedroefd	A (3)	
154. ongesteld	A (4)	
155. oester	N (3)	
156. baken	N (1)	
157. ruïne	N (2)	
158. ledig	A (1)	
159. horisontaal	A (3)	
160. peins	W (2)	
161. stuit	W (2)	
162. werpsel	N (1)	
163. fes	N (4)	
164. beur	W (1)	
165. eksamineer	W (3)	
166. tugtig	W (2)	
167. visie	N (3)	
168. dy	N (4)	
169. formasie	N (1)	
170. komponis	N (2)	
171. parasiet	N (4)	
172. duet	N (2)	
173. geoloog	N (4)	
174. infanterie	N (1)	
175. respirasie	N (3)	

KWALITATIEWE ANALISE:

naamwoord = N
werkwoord = W
adjektief = A
voorsetsel = V

8.23

Clinical Evaluation of Language Functions

Diagnostic Battery

Eleanor Messing Semel
Elisabeth H. Wiig

CHARLES E. MERRILL PUBLISHING CO.
A BELL & HOWELL COMPANY
COLUMBUS, OHIO 43216

Name ______________________ Date ______________

Birthdate ______________ Grade ______________ Sex ______

School ______________________ Teacher ______________

Home Address ______________________________________

____

Other Relevant Background Information ______________________

____

____

____

SUMMARY TABLE: CRITERION SCORES/RAW SCORES

SUBTEST	1	2	3	4	5	6	7 NO. CORR.	7 MAX. SECS.	7 NO. CORR.	7 MAX SECS.	8 NO. CORR.	8 MAX. SECS.	9	10	11	12	13	13	13
Total Possible	52	44	44	64	50	34	7	—	12	—	36	—	—	60	96	120	52	18	20
0-12	44	36	38	50	42	16	7	10	12	15	32	90	34	46	35	115	52	18	20
9	44	36	38	48	42	16	7	10	12	15	32	90	32	44	35	115	52	18	20
8	44	36	38	46	40	14	7	10	12	15	32	90	30	42	35	115	52	18	20
7	42	36	36	44	38	12	7	10	12	15	32	90	28	40	35	115	52	18	20
6	42	36	36	42	38	12	7	10	12	15	32	90	26	38	35	115	52	18	20
5	40	34	36	40	36	12	7	10	12	15	32	90	24	38	30	115	52	18	20
4	38	30	34	36	32	8	7	10	12	20	32	100	20	36	25	115	50	18	20
3	36	22	32	34	28	6	7	15	—	—	32	100	18	32	20	110	48	18	20
2	34	16	30	30	24	6	7	20	—	—	32	120	16	26	18	100	38	16	18
1	26	10	28	18	16	4	—	—	—	—	32	120	12	22	16	100	36	14	16
K	24	8	26	12	10	2	—	—	—	—	32	120	10	18	8	82	34	12	14

To use the above summary table: 1) Transfer each subtest raw score to the column for that subtest, next to the criterion score at *the child's grade level*. 2) Compare each subtest raw score with the criterion score. 3) Determine the number of subtests on which the child is below criterion. Criteria should be considered experimental.

7. PRODUKSIE VAN WOORDREEKSE

ITEM 1: Wat is die name van die dae van die week?

Maandag Dinsdag Woensdag Donderdag Vrydag Saterdag Sondag

ITEM 2: Wat is die name van die maande van die jaar?

Januarie Februarie Maart April Mei Junie Julie Augustus

September Oktober November Desember

Foutanaliese:

Teken die kind se response op en analiseer vir fout tipe (die tipe fout). Maak gebruik van die uiteensetting in die handleiding. Teken die fout tipe aan op die tabel.

Fout Tipe	Item 1	Item 2	Totale fout tipe	% van alle foute
Vervanging				
Weglating				
Herhaling				
Verplasing				
TOTALE FOUTE				

8. PRODUKSIE VAN NAME OP VERSOEK

Die kind moet elke item benoem, merk enige weglatings of vervangings.

KAART 1: BENOEMING VAN KLEURE

1. blou	2. rooi	3. swart	4. swart	5. rooi	6. rooi
7. geel	8. rooi	9. rooi	10. swart	11. swart	12. blou
13. geel	14. blou	15. blou	16. rooi	17. blou	18. rooi
19. rooi	20. geel	21. swart	22. blou	23. geel	24. swart
25. blou	26. swart	27. swart	28. geel	29. blou	30. geel
31. geel	32. rooi	33. geel	34. geel	35. blou	36. swart

Totaal Korrek:

Totaal Foutief:

Totale Tyd (Sek):

KAART 2: BENOEMING VAN VORMS

1. sirkel	2. vierkant	3. vierkant	4. driehoek	5. driehoek	6. vierkant
7. sirkel	8. sirkel	9. driehoek	10. vierkant	11. sirkel	12. vierkant
13. vierkant	14. vierkant	15. sirkel	16. sirkel	17. vierkant	18. vierkant
19. sirkel	20. driehoek	21. sirkel	22. sirkel	23. sirkel	24. driehoek
25. driehoek	26. vierkant	27. sirkel	28. driehoek	29. driehoek	30. driehoek
31. vierkant	32. driehoek	33. vierkant	34. vierkant	35. driehoek	36. driehoek

Totaal Korrek:

Totaal Foutief:

Totale Tyd (sek):

KAART 3: BENOEMING VAN KLEUR EN VORM

1.	blou sirkel	2.	rooi vierkant	3.	swart vierkant	4.	swart driehoek
5.	rooi driehoek	6.	rooi vierkant	7.	geel sirkel	8.	rooi sirkel
9.	rooi driehoek	10.	swart vierkant	11.	swart sirkel	12.	blou vierkant
13.	geel vierkant	14.	blou vierkant	15.	blou sirkel	16.	rooi sirkel
17.	blou vierkant	18.	rooi vierkant	19.	rooi sirkel	20.	geel driehoek
21.	swart sirkel	22.	blou sirkel	23.	geel sirkel	24.	swart driehoek
25.	blou driehoek	26.	swart vierkant	27.	swart sirkel	28.	geel driehoek
29.	blou driehoek	30.	geel driehoek	31.	geel sirkel	32.	rooi driehoek
33.	geel vierkant	34.	geel vierkant	35.	blou driehoek	36.	swart driehoek

Totaal Korrek:

Totaal Foutief:

Totale Tyd (sek):

9. PRODUKSIE VAN WOORD ASSOSIASIES

REEKS 1: KOSSOORTE

TOTAAL KORREK:

KWALITATIEWE ANALISE
(gaan benoemde subklasse na)

	Maaltye	Vrugte	Groente	Broode	Vleissoorte	Suiwel-produkte	Vernaamste kossoorte	Soppe	Hoofgeregte	Kits kossoorte	Poedings	Happie (ligte maal-tyd)	Toebroodjies	Ander
1.														
2.														
3.														
4.														
5.														
6.														
7.														
8.														
9.														
10.														
11.														
12.														
13.														
14.														
15.														
16.														
17.														
18.														
19.														
20.														

REEKS II: DIERSOORTE

TOTAAL KORREK:

1.	
2.	
3.	
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19.	
20.	

KWALITATIEWE ANALISE
(gaan benoemde subklasse na)

Troeteldiere																				
Plaasdiere																				
Wildediere																				
Vissoorte																				
Voëlsoorte																				
Soogdiere																				
Insekte																				
Reptiele																				
Ander																				
Ander																				

10. PRODUKSIE VAN MODELSINNE:

Vir foutanaliese teken die kind se response aan, in die spasie onder elke stimulus sin.

ITEM	Respons	korrek	2e brt.	foutief	geen rsp.
1. Die hond het die kat gejaag.		2	1	0	N
2. Het die seun die bal geraak?		2	1	0	N
3. Is die motor deur die polisie gevolg?		2	1	0	N
4. Het die haas nie die wortel geëet nie?		2	1	0	N
5. Die seun het nie die meisie gejaag nie.		2	1	0	N
6. Die trein is deur die motor gevolg.		2	1	0	N
7. Is die roomys nie deur die meisie gekoop nie?		2	1	0	N
8. As die bal rol sal die kat dit jaag?		2	1	0	N
9. Die seun en die meisie het die blomme gepluk.		2	1	0	N
10. Die hond het die bal gejaag en die kat het gevolg.		2	1	0	N
11. Die kaas is nie deur die muis gevreet nie.		2	1	0	N
12. Die kinders het die prente gesny en geplak.		2	1	0	N

ITEM	Respons	korrek	2e brt.	foutief	geen rsp.
13. Die rivier het nie die renoster gekruis nie.		2	1	0	N
14. Die man wat die trap geverf het, was baie gaaf.		2	1	0	N
15. Indien die koekies gebak was, sou hulle opgeëet gewees het.		2	1	0	N
16. Die prent wat die persoon geverf het was baie gaaf.		2	1	0	N
17. Die groot bruin hond het die rooi bal gejaag.		2	1	0	N
18. Het die duikboot die slagskepe gejaag?		2	1	0	N
19. Die trompette en die viole is deur die orkes bespeel.		2	1	0	N
20. Nie die bal het die huis gesien hardloop.		2	1	0	N
21. Die baba wat langsaan bly, het die hele nag gehuil.		2	1	0	N
22. Die posman het die briewe gesorteer en daarna het hy hulle afgelewer.		2	1	0	N
23. Was afgelewer die blomme deur die bode?		2	1	0	N
24. By die gedig was nie geskryf die digter.		2	1	0	N

ITEM	Respons	korrek	2e brt.	foutief	geen rsp.
25. Die vrou het die twaalf groot swaar bruin boeke gelees.		2	1	0	N
26. Nie die voetbalspeler môre het gelag van die stasie huis toe.		2	1	0	N
27. Die seun en sy tannie wat in die huisie langsaan bly, het besluit om op reis te gaan.		2	1	0	N
28. Die man wat op die bank langs die groot boom sit, is die burgemeester.		2	1	0	N
29. Die groot twaalf bruin swaar pakkies het die man gedra.		2	1	0	N
30. Die posman het die tydskrifte gesorteer, gemerk, gebundel en afgelewer.		2	1	0	N

TOTAAL TELLING:

10. PRODUKSIE VAN MODELSINNE:

Foutanaliese:

Transformasie	Item Nommer
Aktief, bevestigend, verklarend	1,17,25
Negatief	5 of 4
Passief	6
Vraend	2,18
Passief, negatief	11
Passief, vraend	3
Negatief, vraend	4
Passief, negatief, vraend	7
Neweskikkend	10,22
Voegwoord weglating	9,12,19,30
"As" voegwoord	8,15
Betreklike sinsdeel	14,21,27,28
Sintaktiese variasie	13,16,23,24,29
Semantiese variasie	20,26
TOTAAL	
SUBTOETS	(30 items)

11. PRODUKSIE VAN GEFORMULEERDE SINNE

Verwysings raamwerk vir die aanteken van sinstipes:

	PUNTE TOEKENNING
1. Onvolledige of agrammatiese sinne	0
2. Eenvoudige sinne	1
3. Eenvoudige sinne met saamgestelde onderwerp, w.w. of voorwerp	2
4. Eenvoudige sinne en frase(s)	3
5. Saamgestelde sinne	4
6. Negatiewe sinne	5
7. Vraende sinne	6
8. Komplekse sinne en neweskikkende voegwoord	7
9. Komplekse sinne en betreklike sinsdeel en/of ingebedde	8

11. PRODUKSIE VAN GEFORMULEERDE SINNE:

ITEM	RESPONS	TELLING
1. Maak 'n sin met die woord MOTOR		
2. Maak 'n sin met die woord GEEL		
3. Maak 'n sin met die woord KINDERS		
4. Maak 'n sin met die woord NIKS		
5. Maak 'n sin met die woord WAT		
6. Maak 'n sin met die woord BEHOORT		
7. Maak 'n sin met die woord OMDAT		
8. Maak 'n sin met die woord STADIG		
9. Maak 'n sin met die woord NADAT		
10. Maak 'n sin met die woord VERTEL		
11. Maak 'n sin met die woord HAARSELF		
12. Maak 'n sin met die woord AS		

TOTAAL TELLING:

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Universiteit van Pretoria

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AFRIKAANSE ARTIKULASIE-ONDERSOEK

NAAM: .... GEBOORTEDATUM:..................................

TERAPEUT (TOETS): .... TERAPEUT(TERAPIE):...............................

TOETS ALLEENLIK VIR ENKELKLANKE: tot nr 32

Enkelklanke

	I	M	F
1.p			
2.b			
3.m			
4.f			
5.v			
6.t			
7.d			
8.n			
9.1			
10.r			
11.s			
12.k			
13.x			
14.			
15.			
16.j			
17.g			
18.			
19.z			

Klankkombinasies

Aanvangsklanke

20.p1	
21.bl	
22.fl	
23.s1	
24.k1	
25.x1	
26.pr	
27.br	
28.tr	
29.dr	
30.kr	
31.xr	
32.sw	
33.kw	
34.kn	
35.sp	
36.st	
37.sk	

38.spr	
39.str	
40.skr	

Eindklanke

41.1p	
42.1f	
43.1t	
44.1s	
45.1k	
46.rt	
47.rs	
48.rk	
49.rx	
50. k	
51.nt	
52.ts	
53.ks	
54. c	

2

1. 1 46
p e rd

2. 9 1
l e p e l

3. 11 1
s ee p

4. 2 3
b oo m

5. 2
b a b a

6. 3 9
m ie l ie

7. 3 10
e mm e r

8. 4 48
v u rk

9. 4 51
o l i f a nt

10. 36 4
st oo f

11. 5 6
w a t e r

12. 30 8
kr aa n

13. 29 5
dr ui w e

14. 6 9
t a f e l

15. 27 6
br oo d

16. 7
d eu r

17. 18 12 7
sj o k o l a d e

18. 8 11
n eu s

19. 37 8
sk oe n e

20. 10 12
r o k

21. 21 10
bl a r e

22. 11 14
p ie s a ng

23.

23. 12
k a t

24. 13 43
g e ld

25. 13
g o gg a

26. 22 13
vl ie gt ui g

27. 14 47
v i ng e rs

28. 15
h ui s

29. 16
j a s

30. 17 42
gh o lf

31. 18
m a sj ie n

32. 18
z e br a

33. 20
pl ei st er

34. 23 44
sl eu t e ls

35. 24
kl i pp e

36. 25
gl a s

37. 26
pr o p

38. 28
tr ei n

39. 31
gr a s

40. 32
sw e m

41. 33
kw a s

42. 34
kn oo p

43. 35
sp ie ë l

44. 38
spr i ng

45. 39
str y k

46. 40
skr y f

47. 41
sk u lp

48. 45
w o lk e

49. 49
b e rg

50. 50
dr i nk

51. 52
f ie ts

52. 53
B o ks

53. 54
s eu ntj ie

VSA (Voice Skills Assessment Battery)

Voice skills assessment rating scale

Airstream:	Control established ☐	Overall problem ☐	Segmental errors ☐	
Voice quality:	Normal ☐ Whisper ☐	Breathy ☐	Tense ☐	Creaky ☐
Pitch range:	Normal ☐	Too wide ☐	Too narrow ☐	
Pitch control:	Established ☐	Fluctuating ☐		
Pitch variability: normal	High versus restricted ☐	Monotonous ☐	Drifts down at end of sentence ☐	
	Drifts up at end of sentence ☐			
Loudness:	Control established ☐	Poor control ☐		
Rate of delivery:	Normal ☐	Too fast ☐	Too slow ☐	
Resonance:	Acceptable ☐	Hypernasal ☐	Hyponasal ☐	Segmental errors ☐
Rhythm:	Stress timing ☐ Sound timing ☐	Syllable timing ☐	Word timing ☐	
Intonation:	Full set of English contrasts ☐ Contrast by altering length ☐	Contrast absent/or stereotype pattern ☐ Contrast by altering loudness ☐		

SIR (Speech Intelligibility Rating)

Speech intelligibility rating (SIR)

Category	*Speech Intelligibility Rating*
6	Speech intelligible to all listeners
5	Speech intelligible to listeners with little experience of the speech of a deaf speaker
4	Speech intelligible to a listener who concentrates and lipreads
3	Speech unintelligible. Experienced listeners can follow a known topic via lipreading and context cues. It is not possible to follow an audio-tape sample
2	The primary mode of communication is manual. The speech or vocalisation patterns which accompany the use of sign/ gesture may give some additional information at the lipreading level
1	Pre-recognisable words in spoken language