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Normative data for Frequency Patterns Test in assessment of Central Auditory Processing Disorders for South African children aged 8 to 11years.

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Abstract

Background: A central auditory processing disorder (CAPD) is a disorder that presents in individuals as having difficulty understanding fast and degraded speech, understanding verbal instructions, and struggling to hear in background noise, these difficulties are not due to a peripheral hearing loss. Additional secondary effects of CAPD have been well documented to affect school aged children, therefore, making early diagnosis and intervention important for their development. The central tests currently used for testing in South Africa have materials and normative data that were developed from an American population of English first language speakers. In addition, many of the tests in the assessment battery have a high linguistic load. This raises a challenge in the South African population of first language English speakers and the majority of the population who are not first language English speakers. To reduce misdiagnosis, it is important to generate context-specific normative data from a South African test population. By developing normative data for the FPT in SA children it may assist in the accurate diagnosis of CAPD following assessment and contribute to the development of SA specific data.

Aim 1: To develop context-specific normative data for the FPT in SA children aged 8- 11 years.

Aim 2: To determine the relationship between existing American normative data and newly generated South African normative data.

Methodology: A non-experimental comparative descriptive study design was conducted. There were 35 potential participants from 5 schools within the vicinity of the university. Results from 26 participants were included in the study analysis of the FPT and these results were developed into the normative data set.

Results: The results from the 26 participants showed that results from the humming response were higher than the verbal response bilaterally. This was noted for all the age groups. In addition, the comparison for the generated normative data and the American data showed no significant difference between the two data sets in the description response. The comparison of the humming

response revealed significantly higher responses in the generated normative data over the American data. This was seen across all the age groups.

Conclusion: In addressing aim 1, the findings reveal that the FPT as an assessment is not affected by language however, the performance in the test may be affected by the language it is administered in. Additionally, the findings confirm a need for age specific data as the results improved with age showing the neuromaturation of the CANS as the children grow. Regarding aim 2, the results of this study show that there are some differences between the data sets from the two populations which is seen in other studies as well confirming the need for context specific normative data. The data set for this study was small and cannot be generalised to the whole S.A. population, therefore the data may be used as a first step in the development of a full set of normative data for the FPT. The study does inform the need for further research and a larger scale study for context specific data.

Keywords: Central Auditory Processing Disorder (CAPD); Frequency Patterns Test (FPT); school-aged children; normative data.

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Abbreviations

- **AAA-** American Academy of Audiology
- **ABR-** Auditory Brainstem Response
- **APD-** Auditory Processing Disorder
- **ASHA-** American Speech-Language and Hearing Association
- **CANS-** Central Auditory Nervous System
- **CNS**- Central Nervous System
- **CAP-** Central Auditory Processing
- **CAPD-** Central Auditory Processing Disorder
- **DPT-** Duration Pattern Test
- **ENT-** Ear, Nose and Throat specialist
- **FPT-** Frequency Patterns Test
- **LLL-** Low Linguistically Loaded test
- **MAPA**- Multiple Auditory Processing Assessment
- **MLR-** Middle Latency Response
- **PPDT-** Psychoacoustic Pattern Discrimination Test
- **REA**- Right Ear Advantage
- **RSA-** Republic of South Africa
- **SA-** South Africa
- **STA-** Speech Therapist and Audiologist
- **STA/A-** Speech Therapist and Audiologist/ Audiologist
- **UCT-** University of Cape Town

CHAPTER 1: INTRODUCTION

In the field of Audiology there is a need for the development of assessments and normative data that are context specific for the appropriate administration of behavioural assessments (Bantwal, 2011; Bellis, 1996). This is the case in the area of Central Auditory Processing Disorder (CAPD) assessments, as such this study will aim to determine preliminary normative data for the Frequency Patterns Test for the assessment of CAPD. CAPD is an auditory perception disorder that currently has no universal definition. The most widely used definition is taken from the American Speech-Language-Hearing Association, which states that CAPD is a deficit in the perceptual processing of auditory information, which can manifest with difficulties in one or more of these abilities: auditory discrimination, temporal integration and discrimination, sound localisation and lateralisation and auditory processing of acoustic signals (ASHA, 2005). Jerger & Musiek (2000), state that individuals with CAPD are often perceived to have a hearing loss and struggle with listening when there is background noise, they struggle to understand fast degraded speech and have difficulty in understanding verbal instructions. Even with normal hearing thresholds, individuals with CAPD may have listening difficulties. Secondary effects of CAPD include speech and language difficulties, poor academic performance, learning difficulties and a negative impact on social interactions (Chermak & Musiek, 1997). Fouche-Copley, Govender & Khan (2016), have highlight that these challenges have been seen in both the paediatric and adult South African populations.

It is not clear what causes CAPD, however, some theories suggest that CAPD may be caused by abnormal neurophysiologic representation of auditory stimuli, head trauma, neurologic disorders and diseases, neurologic abnormality and deterioration or accumulated damage of the central auditory nervous system (CANS) (Chermak & Musiek, 2007). A comprehensive investigation of the CANS is therefore required in order to confirm a diagnosis of CAPD. The CANS has complex and intricate neural networks. This can be seen in the processing of auditory information where there are a number of sub-processes required for efficient auditory signal processing (Baran, 2007; Bellis, 2011; Bellis & Bellis, 2015). Different areas of the CANS perform different auditory processing functions, where the brainstem contains neural pathways to transmit the auditory stimulus (Bellis, 2011). The two hemispheres are involved with varied processing abilities, where the left hemisphere is responsible for processing phonological discrimination, syntactic and semantics of language and the right hemisphere is responsible for music perception and other acoustic contours. The corpus callosum is responsible the interhemispheric transfer of auditory information (Bellis, 2011).

A test battery (set of tests) approach is therefore recommended in the assessment of CAPD as the various CAP tests assess different areas of the CANS using different types of stimuli such as speech and tonal stimuli. The CAP test battery typically includes both electrophysiological and behavioural tests. This approach allows for a detailed description of the patient's auditory processing abilities and assists with identification of the site of lesion. The central tests in the battery should include temporal processing, dichotic tests, monaural low redundancy tests, binaural interaction tests (Refer to Appendix A for the assessment category, the tests and the process assessed), as well as electrophysiological tests (such as the auditory brainstem response (ABR) and the middle latency evoked response (MLR) tests) (Musiek, 1999; Chermak, Bamiou, Iliadou & Musiek, 2017). However, before administering these central tests it is recommended that pure tone audiometry is first administered to rule out peripheral hearing loss that may contribute to any difficulties the individual may have (Campbell & Wilson, 2003). The tests in the battery should be chosen based on a few factors such as the age of the child or adult, their peripheral hearing status, their linguistic proficiency and other factors (Bellis & Bellis, 2015). These factors are important to consider, especially the linguistic proficiency of the patient, as each test has varying degrees of linguistic demand in them (Bellis & Bellis, 2015). Tests that use sentences have a higher linguistic load placed on the patient, tests that use digits and words have a low linguistic load and tests that use tones have no linguistic load (South African Central Auditory Processing Taskforce, 2000; 2001). This will be further discussed in the literature review.

Statistics South Africa (2014), states that South Africa is a linguistically diverse country with 11 official spoken languages where it is inferred that 86% of South Africans do not consider English as their first language. Pascoe & Norman (2011) further indicate that this services as a challenge for a plethora of South Africans as the majority of audiologists are English or Afrikaans speakers. The distribution of audiologists and speech therapists by race can be further seen in a study conducted by Pillay, Tiwari, Kathard & Chikte (2020) which highlights the following demographics: Whites 59.9%, Indians 15.5%, Black 15.2%, Coloured 4.8% and unknown 4.8%. In S.A. race is closely linked to the different cultures and languages found in the country (Pillay et al., 2020). Most CAPD test materials are in English and normative data for the test analysis are generated in English (first language) speakers. This impacts on the accuracy of test findings and subsequent diagnosis of CAPD (Ferguson, 2014; Fouche-Copley et al., 2016). Therefore, the tests are not administered due to an evident language barrier to majority of the patients (South African Central Auditory Processing Taskforce, 2001; Fouche-Copley et al., 2016), and if the tests are administered, unreliable results are obtained in many cases (SA CAPD taskforce, 2001). The lack

of appropriate materials, normative data and clear guidelines for testing and diagnosis leads to fewer audiologists practicing in CAPD.

It is suggested that the content of tests and its normative data should be based on the population for which the test is intended (Bantwal, 2011; Kelly, 2007; Bellis, 1996). Furthermore, Kelly (2007) suggests that if test results are dependent on understanding verbal cues, then materials should be re-recorded by a local speaker in order to remove any accent effects from a foreign speaker. In particular, age specific data is required especially in children due to the effect of neuromaturation throughout childhood. It is well-established that as children grow and mature, their performance in CAPD tests improves. This is due to the different areas of the Central Nervous System (CNS) maturing at different stages as the child grows, with the structures needed for more complex auditory processing, such as the corpus callosum, developing later in the adolescent and adult stages (Bellis, 2011).

In light of the challenges and the gaps raised in CAPD assessments, this study aims to address the need for context-specific normative data for the FPT in the assessment of CAPD. A review of the literature will be done to highlight the need for context specific data. This will be followed by the process taken during the study to develop a normative data set for S.A children aged 8 – 11 years old. Finally, the data generated will be compared to the existing American-Bellis data.

CHAPTER 2: LITERATURE REVIEW

This literature review will look at the challenges faced in S.A. in the field of audiology. The review will further highlight the background of CAPD, CAPD assessment and the state of CAPD in S.A. This will be followed by what the recommended assessment battery is for the South African context and finally the importance of developing context specific normative data.

2.1 Background of CAPD

As discussed in the introduction CAPD has many effects on communication and social development. This is especially important in children as they are still acquiring the language and learning skills needed for academic and social success. Several studies from Poland (Skarzynski, Wlodarczyk, Kochanek, Pilka, Jedrzejczak, Olszewski, Bruski, Niedzielski & Skarzynski, 2015), United States of America (Chermak, Bellis & Musiek, 2007), the United Kingdom (Schow, Whitaker, Seikel, Brokett & Vieira, 2020), India (Bantwal, 2011) and Western Iran (Moloudi, Rouzbahani, Rahbar & Saneie, 2018), highlight that between 2-7% of school aged children are diagnosed and affected with CAPD (Tawfik, Hassan & Mesallamy, 2015; Mattsson, Follestad, Andersson, Lind, Oygarden & Nordgard, 2018;). Therefore, the need for early identification is important in children.

For the assessment of CAPD it is important to note that there are some debates about the aforementioned test battery as a standard or effective test battery for the diagnosis of CAPD. Most of this debates are centered around i) the specific tests that should be included in the test battery, ii) varying views about the diagnostic criteria that should be used for diagnosis and iii) classification of CAPD in an individual (Wilson & Arnott, 2013; Iliadou, Ptok, Grech, Pedersen, Brechmann, Deggouj, Kiese-Himmel, Sliwinska-Kowalska, Nickisch, Demanez, Veuillet, Thai-Van, Sirimanna, Callimachou, Santarelli, Kuske, Barajas, Hedjever, Konukseven, Veraguth, Mattsson, Martins & Bamiou, 2017). There are several guidelines that make use of the test battery approach with subtle differences that audiologists use to assess CAPD. The RSA CAPD5 taskforce document (2001) recommends a low linguistically loaded test battery with an assessment from each category, 2 from dichotic digits, 1 from temporal ordering, 1 from monaural low-redundancy and 1 from binaural fusion. Bellis (2003) recommends 1 assessment from each test category, AAA (2010) recommends selecting a test from each category namely: dichotic

listening tests, temporal sequencing tests and monaural low-redundancy speech tests and ASHA uses the recommendation from AAA (Fouche-Copley, Govender & Khan, 2016). The Farlex Partner Medical Dictionary (2012, as cited in Chermak, Iliadou, Bamiou & Musiek, 2018) states that a gold standard for diagnosis is the best available and most widely used method. Therefore, a minimal test battery that draws from the varied guidelines as mentioned above, which combines several assessments that cover the different areas of processing is currently used (American Academy of Audiology, 2010). This is seen as a "reasonable compromise" and is appropriate for diagnosing because the tests have been shown to have good test efficiency and they assess the entire CANS. Guidelines from the American Academy of Audiology (2010) state that the best gold standard approach is through research which entails refining the test battery used and to determine the most effective test combinations.

This search for the gold standard would involve careful consideration of the different central tests, its efficiency and test properties (American Academy of Audiology, 2010). In addition, the test variables that could influence test administration and the interpretation of results, should also be considered. Iliadou et al., (2017), state that language and cognitive confounds need to be minimised when selecting auditory processing assessments. Some of the variables that need to be considered for effective diagnosis of CAPD are the native language, the language age, which is the number of years a language has been used by a person and the language experience of the patient (Jerger & Musiek, 2000). In addition, considerations of linguistic demand, mode of response, practice effects and cognitive demands of the test are essential (Iliadou et al., 2017). Iliadou et al., (2017) further highlight that the language development of the individual and identifying any language development impairments the individual may have also play a fundamental role. These factors must be considered when administering and analysing test results in order to ensure that the results are a true reflection of the patient's ability. This consideration can be seen in a study by Mattsson et al., (2018), which aimed to create normative data for diagnosing APD in Norwegian children aged 7-12 years old. Where prior to administering the assessments in the study, the tests used from the battery were adapted and translated into Danish as well as Norwegian. Emphasis was placed on the tests containing words and numbers, so that the tests were familiar and the dialect was neutral even for children from the age of seven.

2.2 CAPD assessment: Temporal Processing

To achieve the aims of this current study, the focus will be on the temporal processing assessment category which looks at processes of auditory discrimination, temporal processing and temporal ordering (Musiek, 1999 and Shinn, 2007). Temporal processing forms part of the primary component of many auditory processing abilities and is dependent on cerebral and interhemispheric processing (Shinn, 2007). It is further explained that in order to understand your surroundings, the auditory system is required to create a complete auditory percept (Banai & Kraus, 2006). This is achieved by being sensitive to the timing of acoustic sounds, the ability to shift between that timing and combine all the different information (Banai & Kraus, 2006; Bellis & Bellis, 2018). Musiek (1999) explains that temporal processing is important for normal audition, where the CANS is a timekeeper and the temporal assessments tell us how well it is working. According to Musiek and Chermak (2015), timing is important for all acoustic signals making temporal processing essential for all central auditory processes. In addition, temporal tests have been found to have good diagnostic power which will be discussed below, therefore making it important to include a temporal processing assessment in central auditory processing test batteries (Musiek & Chermak, 2015). Processing sounds such as speech and music gives information on frequency discrimination (Fadel, Ribas, Luders, Fonseca & Cat, 2018). This information would have an impact on the CANS because the temporal structures form part of the main source of hearing information (Fadel et al., 2018). For CAPD assessment, the temporal processing test category includes FPT, Duration Patterns Test (DPT) and Psychoacoustic Pattern Discrimination Test (PPDT) (Shinn, 2003, Musiek, 1999; Chermak, Bamiou, Iliadou & Musiek, 2017).

The present study will focus on FPT because according to Musiek, Pinheiro & Wilson (1980, as cited in Musiek, 1999) the FPT assesses detection of sound features, labelling of sounds, frequency discrimination, recognition of changes in sound and some memory function. FPT is able to identify possible deficits that occur in both hemispheres of the brain, in a single hemisphere (the left or the right) and in the corpus callosum (Musiek, 1999). Therefore, the FPT is typically included in CAP test batteries for high diagnostic power and for varied target assessment areas. The FPT can be administered easily and has high acoustic fidelity (Musiek, 1994). The patient can respond by humming the sequences, which makes the test sensitive to right hemisphere lesions. Alternatively, the patient can verbally label the sequences which makes the test sensitive to the right and left hemisphere and/or interhemispheric pathway lesions on the corpus callosum (Baran, 2007; Bellis, 2011).

The test has a sensitivity and specificity of above 80% for cerebral lesions and a sensitivity of mid 50% for Brainstem lesions, even in patients with mild cochlear hearing loss (Musiek, 1999). The FPT has also been used as an important part of CAPD screening (Schow & Seikel, 2007). It is used as a screening tool in the Multiple Auditory Processing Assessment (MAPA) where the screening tool has a sensitivity of 89% and a specificity of 82% (Schow et al., 2020). The FPT within the screening tool has a sensitivity of 74% (Schow & Seikel, 2007). This sensitivity value was found through tests conducted by Summers (2003, as cited in Schow & Seikel, 2007) on 119 children using all the screening tests in the MAPA battery, where the results underwent the factor analysis statistical procedure. It is important to note that the screening version of the FPT differs from the diagnostic test as its sequences have 4 tone-bursts instead of 3 tone-bursts (Schow & Seikel, 2007). The screening is important as it assists in reducing the overall costs of performing full diagnostic assessments and makes identification of CAPD and rehabilitation more efficient (Bellis, 2011). In CAPD, screening refers to a battery of tests used to determine if further diagnostic assessment is required in children that are already showing signs of communication difficulties and have been flagged for CAPD issues (Bellis, 2011). Therefore, including an assessment such as the FPT in the screening battery allows for several areas on the brain to be assessed, with certainty in the strength of the result (Bellis, 2011).

The CAP test materials are available on the 'Tonal and speech material for auditory perception assessment': this is a collection of assessments for central auditory function developed by the Department of Veteran Affairs (Noffsinger, Wilson & Musiek, 1994). The disc was developed to aid in creating a standardized test battery to be used in clinical practice which assesses a variety of auditory processes and a variety of CANS perceptual processes. The materials on the disc were developed and standardized on 120 individuals from across the United States of America made up of 21 males and 99 females, aged 17-32 years with self-reported normal hearing. See Appendix B for a detailed description of the specific tests assessed on the disc. The creators of this assessment battery intended for it to be used by professionals to assess their own populations and create normative data that may be useful for their own populations (Noffsinger, Wilson & Musiek, 1994). Therefore, it is appropriate to use this assessment tool in creating normative data for S.A. children.

2.3 South African context

In the South African context health services are affected by unequal access to health services and inequity between the services in public and private sectors (Pillay et al., 2020). In addition,

the increase in non-communicable diseases such as heart disease, diabetes and stroke, sees the health care system directing the majority of resources to treating disease with there being limited allocation of resources to communication disorders for the assessment, management and further development of the field (Pascoe & Norman, 2011; Fouche-Copley et al., 2016). Audiological service delivery is further constrained by the poor distribution of human resources, with 22% of STA/A (Speech Therapist and Audiologist/ Audiologist) working in the public sector serving 84% of the population and 78% working in private practice serving 16% of the population (Pillay et al., 2020). The restricted resources and number of audiologists and STA's in the public sector, means that more emphasis is put on basic audiological services such as diagnosing and managing commonly occurring conditions and hearing loss to service the majority of the population (Fouche-Copley et al., 2016). More specialised services such as CAPD assessment and management are not prioritised, especially in the public sector (Fouche-Copley et al., 2016).

As mentioned in the introduction, the linguistic diversity of South Africa, the audiologist's language demographics, the lack of context-specific CAPD test materials and normative data have an impact as well on how CAPD service are offered. Ferguson (2014), states that's these challenges negatively impact the validity and reliability of test findings, thus causing inappropriate CAPD diagnosis and management (Fouche-Copley et al., 2016). Due to the matter of no standardized guidelines, it is difficult to advocate for an inclusion of CAPD services in the standard list of audiological services offered in the public sector (Ferguson, 2014 and Fouche-Copley e al, 2016).

In the study by Fouche-Copley et al., (2016) conducted on South African audiologists and STA's, they found that clinicians did not collectively follow a specific set of formal CAPD screening policies or guidelines, due to there being no standardized testing guidelines in place for use. This is seen in the assessment and intervention of CAPD. The lack of appropriate materials, normative data and clear guidelines for testing and diagnosis, lead to fewer South African audiologists practicing in the area of CAPD (Fouche-Copley et al., 2016). In an attempt to address some of the challenges faced in the South African context, the South African CAPD Taskforce was created in October 1999 during the Ear, Nose and Throat (ENT) conference. The taskforce developed and recommended the Low linguistically loaded CAPD Test protocol which can be applied to South African English (first, second and third) language speakers. Low linguistic load test refers to tests that use words, digits and pure tone sounds instead of sentences which have a higher linguistic focus (South African Central Auditory Processing Taskforce, 2000; 2001). Therefore, the South African CAPD taskforce recommended a test battery that has a low linguistic focus or

load that would minimize the effect that a language barrier has on testing and facilitating accurate diagnosis of CAPD.

For this Low linguistically loaded test battery, the main tests recommended from the four assessment categories to form a test battery for children are: 1) low pass filtered speech, 2) frequency patterns test, 3) two pair dichotic digits' test and 4) CVC binaural fusion test. These tests were chosen because they are challenging, yet they are still simple for children to complete and the age specific norms for children are more defined for these four tests than the others (Bellis, 1996; 2003). Frequency patterns are not linguistically loaded and not affected by the language experience the patient has as the test is presented in pure tones. The FPT is used to assess aspects of temporal processing called temporal ordering and auditory discrimination, which have been found to be important in speech perception (Shinn, 2003). According to Banai & Kraus (2006), temporal processing is the auditory system's ability to process quick acoustic sounds and to process changes in the signal over time, and temporal ordering, specifically, refers to the ability to correctly sequence incoming auditory signals. This makes the FPT an appropriate test to be administered in the South African context, where the patient is able to understand instructions and respond appropriately in a language they are most comfortable in without disrupting the integrity of the test. As mentioned, the FPT is administered with pre-recorded tonal stimuli from the Tonal and Speech Material for Auditory Perceptual Assessment (TSMAPA).

The recommendation by Noffsinger, Wilson and Musiek (1994) to use the TSMAPA to create normative data in their own populations, coupled with the Low Linguistically loaded test battery recommended by the South African CAPD taskforce were followed by Campbell & Wilson (2003) in a study. The proposed low linguistically loaded test battery was used to create provisional South African normative data, which was compared to existing American norms generated by Bellis (2003) (Campbell & Wilson, 2003). Their study focused on the performance of 50 English (first language) speaking South African children aged 8 to 12 years old with this test battery: dichotic digits, frequency pattern test, low-pass filtered speech and speech masking level difference test (Campbell & Wilson, 2003). The study findings revealed that the South African children scored significantly lower in all the tests than the American participants whom the norms are based on. The percentage differences ranged from 1.4% – 63.5% less than the Bellis norms (see Appendix D). In the study, it was suggested that the low results from the dichotic digits, low pass filtered speech and the speech masking level difference tests may have been influenced by the American accent in the recorded test material. Despite the assessments having a low linguistic load, there is sufficient language load to affect South African results. The differences in the scores may be

due to the American English accent in the recordings of the test materials, the difficulty of the words and vocabulary used in some of the tests (Campbell & Wilson, 2003).

It was also found that the 8-year-old age group had lower scores overall, therefore it was concluded that this age group's testing should be done with caution. Therefore, the study concluded the Bellis norms were not suitable for use in RSA. The data from the Campbell & Wilson (2003) study were recommended to be used as preliminary data in the interim until a larger scale study can be conducted. The authors also noted that the study results cannot be generalized beyond the participants, the selected parameters of recording and the stimulus due to the small sample size. It was shown through this study that using normative data, which is not context specific, puts the patients at risk of being misdiagnosed with CAPD (Campbell & Wilson, 2003). More specifically, application of the current American norms would result in many false-positives when diagnosing CAPD in South African children as the preliminary South African data are below the current norms. The results from the Campbell & Wilson (2003) study are different from those of the Bellis (1996; 2003) norms. The difference in findings between South African children and the Bellis (1996; 2003) norms was true for both linguistically loaded tests and tests with tonal stimuli such as the frequency patterns test (FPT). Despite these findings, the Bellis norms are still currently used in the South African context as there are no standardized South African norms (Fouche-Copley, Govender & Khan, 2016).

As noted in the Campbell and Wilson (2003) study, the performance standard of these tests is different in various populations. It is with this that Bellis (1996) recommended that practitioners collect local normative data for testing and adapted test materials to remove the effect of foreign accents on test performance. Following this recommendation, researchers in New Zealand aimed to create normative data for behavioural tests for CAPD assessment in school going children aged 7-12 years old (Kelly, 2007). They noted differences when comparing their findings from population specific research to the widely used American-Bellis norms. Table 1 compares normative data sets for the frequency patterns test (FPT) from United States of America, New Zealand and RSA. The American data is from the Bellis (2003) normative data. The dataset from New Zealand is from the study conducted by Kelly (2007) and it does not report on hummed responses. The South African data is from the study by Campbell and Wilson (2003).

Table 1: American- New Zealand- South African norm comparison (Mean % -2SD)

Results for verbal responses						
Age in Years	**American -Bellis Norms (1996, 2003)**		**New Zealand Norms- Kelly (2007)**		**South African Norms- Campbell & Wilson (2003)**	
	R	**L**	**R**	**L**	**R**	**L**
8	42	42	34.92	32.16	20.4	24.4
9	63	63	64.70	66.22	44.9	49.1
10	78	78			56.7	60.7
11	78	78	73.70	74.51	81.8	70.8
12	80	80			61	56.8
Results for hummed responses						
Age in years	**Bellis Norms (1996, 2003)**			**South African Norms (2003)**		
	R	**L**		**R**	**L**	
8	42	42		39.2	37	
9	63	63		54.8	55.6	
10	78	78		69.3	65.4	
11	78	78		69.9	71	
12	80	80		66.4	65.9	

R- Right ear. L- Left ear

Table 1 illustrates that there are differences between the three data sets. Comparison between the Bellis (1996) norms and Kelly (2007) norms, reveals there is a difference of approximately 10% in the normative data for the 8-year-old group. A difference of approximately 12%-14% in the 9–10-year-old group and of 7% in the 11-12 year old groups. These differences are significant enough to make an impact on the interpretation of test results for diagnosis. The differences between the test performance of South African participants when using the normative data generated on American children are even greater, this can be seen across all age groups for both the verbal and hummed responses. The American–Bellis norms are consistently higher than the S.A. norms with the exception of the 11-year-old verbal response in the right ear, being at 3.8% higher than the American-Bellis norms.

A few limitations were noted by the Campbell & Wilson (2003) and Kelly (2007) studies. Both the Campbell & Wilson (2003) and Kelly (2007) studies recommended that the data be used provisionally until a larger scale study can be conducted. They noted that the participants in their respective studies were gathered from similar backgrounds or geographical areas (Campbell & Wilson, 2003; Kelly, 2007). Additionally, Campbell and Wilson (2003) had concerns about the small sample size in their study.

The linguistic and cultural diversity of a country may also add to the reasons for the differences in the scores (Bantwal, 2011 and Fouche-Copley et al, 2016). Linguistic and cultural differences between populations play an important role in language and cognitive skills especially in children (Bantwal, 2011). This highlights the need for context specific normative data development for South African children. Bellis (1996) recommends, for appropriate administration of behavioural tests, normative data should be collected from the local population. If the populations continue to be tested against a different population group's normative data, children will be misdiagnosed (Bantwal, 2001). Thus, in an effort to address some of the challenges noted, the present study aimed to generate normative data in South African children. Using the FPT, as one of the central tests has shown to have good efficiency and low linguistic load to assist in the diagnosis of CAPD. Thus, a research question was developed: Are the scores for the FPT in South African children different to those of American children?

The subsequent chapters that reveal how this study developed include: Methodology which explains the aims of the research, the research design chosen, the procedures for participant recruitment, data collection and analysis and ethical considerations of the study. This chapter is followed by the Results chapter which reveals the results from the study. The Discussion and Conclusions chapter examine the results obtained. The last chapter will be the Implications and recommendations of this study that have been noted.

CHAPTER 3: METHODOLOGY

3.1 Aims

Aim 1: To develop age specific normative data for the FPT in SA children aged 8- 11 years.

Aim 2: To determine the relationship between existing American normative data and newly generated South African normative data.

3.2 Research Design

A comparative descriptive between subjects' study design was used. This study design is a non-experimental, quantitative research design (Cantrell, 2011). The properties of this study design are: no manipulation of independent variables, no random assignment to groups and often an inclusion of a comparison group. These properties are an advantage of this study design as it caters for studies where the variables are not controlled and have no causal effect on each other (Cantrell, 2011). The limitations of such a study design threatens confidence in study findings due to no control over internal validity and participant characteristics that may affect the results. However, this may be overcome by establishing appropriate inclusion and exclusion criteria (Cantrell, 2011). The study design was chosen as it addresses the aims of this research appropriately. Aim 1 is the descriptive part where the newly generated normative data of the population was described. Aim 2 is the comparative part where a comparison between the existing data and the newly generated normative data was done. The comparative aspect of aim 2 does not include a comparison group from within the study cohort, the comparison of the generated normative data was done against a reference group of normative data that exists.

3.3 Participants

3.3.1 Inclusion and exclusion

The inclusion and exclusion criteria can be seen in Table 2. The inclusion criteria were selected to include the target age group of participants. In addition, for the study to have a representative sample of the population demographics in the Western Cape, the sample includes English, Afrikaans and IsiXhosa speakers. The three language speakers were included as one test group for this purpose of this research however it is important to report on the home languages to show that the FPT assessment is not affected by language (Chermak, et al, 2017). The results section reveals the comparison in assessment scores from the three language groups.

All South African mainstream public schools are categorized into 5 groups called quintiles, this is mainly done for financial resources allocation, where quintile 1-3 schools receive more money per learner than quintile 4 and 5 schools (Western Cape Education Department, 2013). Schools in quintiles 1-3 are no fee paying schools and those in quintiles 4-5 are fee paying schools, the quintiles are determined by the socio economic status and certain infrastructural factors of a community the school is located in (Western Cape education department, 2013). The quintiles of majority of the schools closest to the university are rated 5 (Province of Western Cape, 2009) however, the quintile of the school is not a factor that determined inclusion or exclusion of a school but will be reported on.

The exclusion criteria were chosen to ensure there aren't any conditions of the peripheral auditory system and CANS that may affect the test results. Current diagnosis or a history of any of the conditions or therapy in the exclusion criteria may affect the participant's understanding of the testing process and how they perform in the tests (Majak, Zamyslowska-Szmytke, Rajkowska & Sliwinska-Kowalska, 2015; Chermak, et al, 2017). In addition, CAPD shares the same behavioural deficits seen in cognitive disorders, peripheral hearing loss and language disorders therefore, diagnosis of or history of any of these disorders needs to be excluded. The information required about the exclusion criteria will be obtained through self-report from the participant or the parent/ legal guardian during the case history interview.

Table 2: Inclusion and Exclusion criteria

Inclusion Criteria	Exclusion Criteria
○ School child between the ages of 8-11 years. ○ English, Afrikaans or IsiXhosa home language speaker. ○ Normal Pure tone audiometry and Immitance results.	○ Currently diagnosed and/or history of hearing loss. ○ Currently diagnosed and/or history of cognitive difficulties. ○ Currently diagnosed and/or history of developmental and learning difficulties. ○ Currently diagnosed and/or history of CAPD. ○ Currently diagnosed and/or history of neurological conditions. ○ Currently diagnosed and/or history of speech and language difficulties ○ Currently receiving and/or history of speech therapy or Occupational Therapist processing therapy
○	○

3.3.2 Sample size

Using the G* Power calculation the proposed sample size was 220 participants for two test groups being compared, therefore for this study one test group was required of 110 participants allowing 22 children for each age sub-group (Faul, Erdfelder, Lang & Buchner, 2007). The G power calculation was done to ensure the study has a sample size that has good statistical power to detect a real effect and is both resource and time efficient (Prajapati, Dunne & Armstrong, 2010). See Appendix E, Wilcoxon-Mann-Whitney test parameter was selected as the sample size generated is big enough for normal and non-normal distributions. An effect size of 0.5 was selected to detect medium- large differences in the data, the two tails were selected as a difference in any direction is expected (Prajapati, Dunne & Armstrong, 2010). The number of children assessed was 35. There were several challenges in obtaining the sufficient number of learners required by the proposed sample size. These challenges will be discussed in the study limitations section and a description of the sample will be discussed in the results section.

3.3.3 Sampling method

The sampling was done using purposive sampling in the schools as there was a predetermined type of participants targeted (Trochim, 2000). This was done by targeting learners at five schools that are aged 8- 11 years and are either English, Afrikaans or IsiXhosa speaking to handout information and consent forms to their parents/ legal guardians.

3.3.4 Recruitment setting

As part of the recruitment step in the process of developing normative data participants for the study were recruited from 5 primary schools that are in close proximity to the university campus. Four of the schools are within the 5th quintile government category and one school is fully private. The 5th quintile means that the schools are at the highest quintile category, they received less subsidy from the government and therefore a fee paying schools. The one school that is fully private receives no subsidy from the government and is sustained from school fees. These schools were chosen because they are within 5km of the university and are based on the school screening student clinic sites affiliated with UCT Audiology therefore reducing traveling challenges. More than one school was chosen where similar numbers of learners were recruited at each school therefore allowing the study to have a representative sample.

3.3.5 Method of recruitment

The Department of Basic Education was contacted via email to inform them of the recruitment for research that will take place in the selected school. Included in that email was a copy of the ethical approval letter, the application form to conduct research with schools, consent and case history forms, a copy of the research proposal and a letter from the research supervisors confirming the status of the researcher as a registered student at the university. The Department of Education gave permission to perform the research with the schools, see Appendix F. The researcher organized meetings at each school with the relevant staff members, including the school principal to explain the intentions of the research and request permission to recruit learners.

For recruitment the researcher met with the chosen liaison from each school, whether it was the school principal or administration staff to give them consent forms and information letter to distribute to the learners for their parents or legal guardian. See Appendix G for the consent form and Appendix H for the information letter. Additionally, translated consent forms (see appendix I and appendix J) and translated information letters (see appendix K and appendix L) were translated into Afrikaans and into IsiXhosa, this was done to ensure participants understand what was required of them. The translations were done by two UCT students who major in the respective languages and are first language speakers of Afrikaans or IsiXhosa. Once ethics approval for the study was obtained from the Faculty of Health Sciences Human Research Ethics Committee at UCT, the translations were tested by giving them to one first language Afrikaans speaker and one first language IsiXhosa speaker to back translate the documents into English to verify the accuracy of the translation and that all information was included (Human Research Ethics Committee, 2016). The researcher's contact details are on both forms in the event parents/legal guardians had further questions. An appointment for data collection was made for the learners who returned signed consent forms. The recruitment process was done concurrently with data collection where more forms were distributed when signed forms were collected. This was done so that the testing timetable was not overwhelmed. The parents/legal guardians were given 2 weeks to return the signed consent forms as learners only came to school on a rotational basis, the researcher collected signed forms weekly at the schools.

3.4 Pilot study

A pilot study was conducted to ensure inter-rater reliability between the researcher and two research assistants. The inter-rater reliability needs to be assessed to ensure that the 3 testers are consistent in their assessment methods and are able to obtain the same test results in the collection process of the main study. The process used to conduct the pilot study was the same as the main study to ensure consistency, see the data collection procedures below. There was no additional inter-rater reliability done in the main study. The study was done on 5 participants taken from the recruited sample to maintain the same participant profile. Each tester had an opportunity to test all participants, and the results were compared to assess the level of agreement. Any queries regarding the procedures were discussed to ensure the duties were carried out correctly.

The inter-rater reliability was established using the level of agreement between the researcher and the research assistants using the Cohen's Kappa statistic. A statistic of 0.75 was calculated

where the value indicates substantial agreement between them, see Appendix X (McHugh, 2012) therefore, there was substantial agreement between the researcher and the research assistants to proceed with the testing. Following the agreement results the participant results were added to the pool to be analyzed to create the normative data.

3.5 Data collection

3.5.1 Equipment/ Instruments

The materials used were a Welch Allyn Otoscope for otoscopy, GSI Tympanometer for tympanometry and acoustic reflexes and GSI 61 for pure tone audiometry testing. The apparatus for the FPT included a Sony DVP-NS51P DVD player which was connected to the Madsen Conera 4.0.1.0198 computer based audiometer that has a 2 channel system connected to TDH-39P Telephonics supra-aural headphones through the audio booth. The test material for the FPT was pre-recorded on the Tonal and Speech Material for Auditory Perceptual Assessment Disc 2.0 by Department of Veteran Affairs. The test items for the diagnostic FPT are made up of sequences of three tone-bursts: two of the tone-bursts are the same frequency whereas the third one is different (Baran, 2007). The tones used are a low frequency tone (L;880Hz) and a high frequency tone (H; 1122Hz), a combination of six 3-tone sequences is possible (HHL, HLH, HLL, LLH, LHL and LHH) and 30 test items which consist of different tone sequences are presented to each ear (Baran, 2007), see Appendix C. All testing equipment was calibrated before the data collection commenced. A set of English instructions was created for administering the FPT (see Appendix N), the instructions were translated into Afrikaans and IsiXhosa (see Appendix O and Appendix P). Data was recorded using an audiology recording form and a FPT recording form.

3.5.2 Research Procedures

Once ethical approval was obtained from the Faculty of Health Sciences Human Research Ethics Committee (HREC ref: 275/2020), the participant recruitment commenced in May 2021 followed by data collection. Data collection was done at the UCT Audiology clinical department in the Old Main building at Groote Schuur Hospital, the pure tones and FPT testing was conducted in a sound-proof booth. The precautions taken to manage COVID-19 concerns were as follows: Each

participant was booked in for an individual session to avoid an influx of parents/guardians and participants in the same area at once. Parents/guardians and participants were screening at the entrance to the building by security. Sanitizer was provided before entry into the testing area. Each participant, parent/guardian and the tester had to wear a mask at all times. The researcher/ research assistant sanitized all surfaces, instruments and equipment that they and the participant were in contact with after each session. The two testing rooms used were left open for suitable ventilation when not in use.

Data collection was done by the researcher and two research assistants to ensure consistency throughout testing and to maintain confidentiality by having a limited number of people collecting the data. The research assistants were qualified audiologist that have formal training in the area of CAPD. A meeting facilitated by the researcher was held prior to data collection with the research assistants to explain how to carry out the standard testing procedures, instructions and admin system to ensure uniformity. The meeting included familiarizing the research assistants to the test materials, the recording sheets as well as the standardized instructions in all three languages.

On the test days, the procedure included discussing the consent once again with the parents/legal guardians of the participant and explaining the test procedures. Once the tests and study were explained to the participant they had the opportunity to sign their assent to participate in the study (Human Research Ethics Committee, 2013), for the Assent form in their preferred language (see Appendix Q, Appendix R and Appendix S). This was followed by taking case history which focused on medical, communication and cognitive development history (see Appendix T for an outline of the case history questions). Objective assessments that don't require the participant to actively engage were done in a quiet consultation room located next to the soundproof booth. These tests are (i) otoscopy to exclude outer ear pathologies, (ii) tympanometry which assesses tympanic membrane and middle ear function. Thereafter, the pure tone audiometry was conducted in a soundproof booth to obtain hearing thresholds. The participant was expected to respond using a push button each time the stimulus was heard. The protocol for air conduction pure-tone testing included:

- Testing frequencies 1 kHz, 2 kHz, 4 kHz, 8 kHz, recheck 1kHz (first ear only), 500 Hz and 250 Hz.

- Assess half octave frequencies if there is a difference exceeding 20dBHL between 2 consecutive frequencies.
- Procedure “10dB down, 5dB up” (Modified Hughson-Westlake, 1959)

Speech Detection Threshold (SDT) test was done to check test reliability. The protocol included:

- Participant was familiarized with the Monosyllabic word list by listening to the words at an audible sound level.
- Start level was 30dB HL
- Presented one word at each level.
- The procedure then followed that of the Pure tone testing procedure of “10dB down, 5dB up” until the lowest level at which the speech was detected. (ASHA, 1988).

The SDT used the English and Afrikaans Monosyllabic word lists (see Appendix U), there is no IsiXhosa list. Therefore, the IsiXhosa speaking participants were tested using the English word list, this was appropriate as the participants are in English medium schools. The participant responded by pushing the button when they detected the words. Bone conduction testing and word identification testing were not done as these are included in a diagnostic hearing test and not a basic hearing test (Kreisman, Smart & John, 2015). All the information from the aforementioned tests formed part of the screening step and determined whether or not the learner was included in the study. If the participant received any abnormal test results they were referred a clinic near them for abnormalities in the outer and middle ear and to the UCT diagnostic clinic for any abnormal hearing results.

Once they were included in the sample for the study the FPT was done with them as part of the assessment step. See Appendix V for the clinical assessment norms that was used to analyse test results. The protocol for the FPT included:

- Participant had the test explained to them and were given instructions in their preferred language (see Appendix N, Appendix O and Appendix P).
- Participants had a chance to practice until they understood their task.
- 20 test items were presented to each ear at 50dBSL relative to the 1000Hz threshold (Bellis, 1996, 2003; Saleh, Campbell & Wilson, 2003).
- This process was repeated for each response mode, for the verbal response then repeated again for the hummed response.

Participants had an opportunity to practice for both response modes. Responses for this assessment were done in two stages in each ear, stage one the participant verbally labelled the tones as high or low for the right ear followed by the left ear and stage two they hummed the tones for the right ear followed by the left ear, see Appendix C for the test items. Participants that received test results that were abnormal CAPD results according to Bellis (1996) were then counselled regarding the results along with their parents/legal guardian. They were then referred for full CAPD assessment, counselling and management. Participants with abnormal CAPD results were referred to the UCT 4th year's CAPD assessment and management clinic where arrangements had been made for further testing and management. Referral information was attached to the participants' copy of results should further testing and management be required. Parents/legal guardians were given the option to set-up an appointment for themselves or for the researcher to set up the appointment. These referrals were made on the basis of one test without any rescreens.

The complete participation time was between 45- 60 minutes per participant. The test was conducted Monday to Friday in the afternoon during the school term and throughout the day during school holidays so that the learners did not miss school activities. All the testing was conducted on the same day for each participant, no participants were returned for a second session. They were given a 5 minute break after the pure tone and speech detection testing, before the FPT test was started. Once the testing was completed the participant was given a refreshment pack and the parent/ legal guardian was given R60; R10 for parking and R50 for petrol or travelling expenses. The joint recruitment and data collection stages took 13,5 weeks to complete.

3.5.3 Process for developing normative data

A study by Rivera & Arango-Lasprilla (2017) aimed to develop normative data for psychological tests in a Spanish speaking paediatric population therefore, they developed stepped to follow to create normative data. The framework is linear and in defined steps that allow for clear progression in developing the normative data. This framework was selected as it allows for a process that is simple to follow and a study that is detailed and replicable. The steps developed by Rivera & Arango-Lasprilla (2017) are as follows: step 1- recruitment of sample, step 2- description of instruments, step 3- clinical and demographic interview for participants, step 4- screening tests, step 5- neuropsychological tests, step 6- procedure followed and step 7- statistical analysis. The sample, clinical and demographics interview and the screening tests form part of the steps used in recruiting participants and screening them for the study inclusion. In the instruments step they explain the different screening tools they used for their screening tests. The neuropsychological tests step introduces the different assessments for data collection. This procedure explains the process taken throughout the data collection phase of the study. Finally, the statistical analysis step explains the accuracy of the final sample, the reliability and the normative data collected. In addition, studies by Kelly (2007), Campbell & Wilson (2003) and Saleh, Campbell & Wilson (2003) follow a similar process to create normative data for CAPD assessments to that of Rivera & Arango-Lasprilla (2017). The studies follow a pattern of recruitment that has strict inclusion and exclusion criteria that will allow for a specific population to be assessed, this is followed by standard audiometry testing which forms part of screening assessments to rule out peripheral condition. Once a study population is suitably screened the CAPD assessments are carried out for the study data, followed by analysis to generate the final data set.

To generate the normative data in this study an adapted version of the Rivera & Arango-Lasprilla (2017) study process was used. The adapted process is illustrated in Figure 1. In the adaptation, steps 1 and 2 (Sample and Instruments) were swapped around and changed into Planning and Recruitment respectively. The Planning stage was done to eliminate or minimize any confounding variable that could affect the assessment results therefore, the booking of clinical venues, the development of the resources and calibration of the equipment was done. To address language differences the tools and materials used were translated. In the Recruitment stage purposive process to recruit a representative sample in the required age groups was carried out. Steps 3 and 4 from the original process have been merged into screening stage, in this step it was essential to rule out further confounding variables that may be caused by a peripheral hearing

loss. Steps 5 and 6 have been merged into assessment stage as they explain the instruments used and the procedure for the data collection test for a standardized procedure. Lastly, step 7 remained the statistical analysis step. See Appendix M for a comparison of the original framework and the adapted framework.

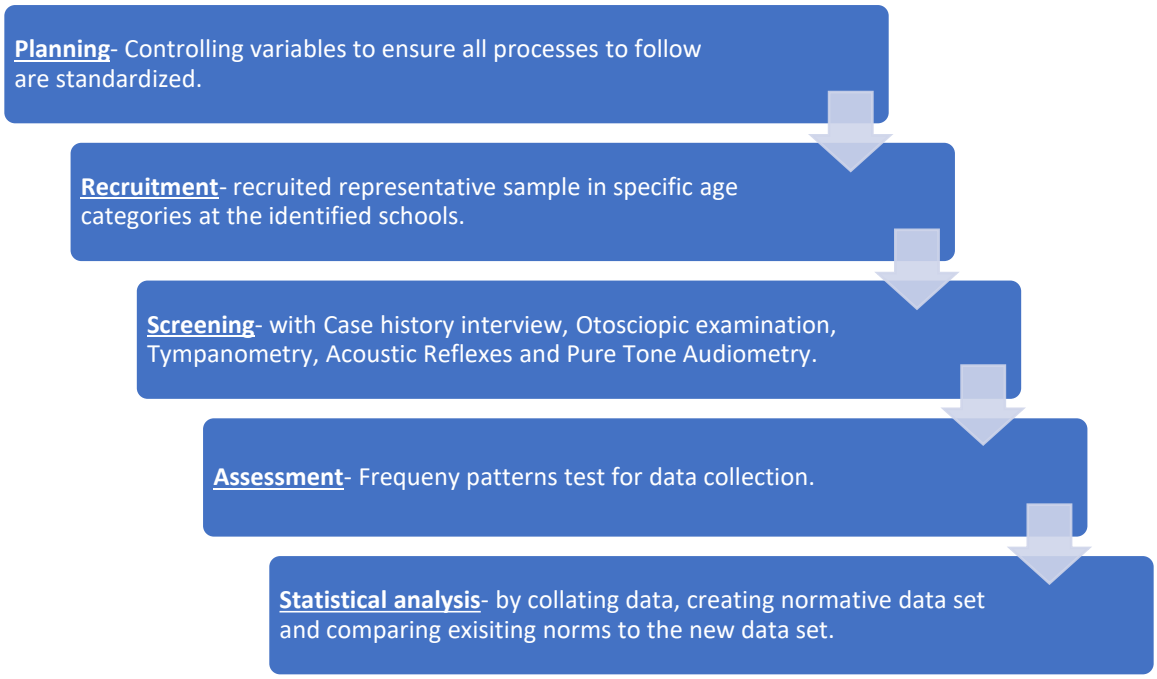

Figure 1: Process of creating normative data adapted from Rivera & Arango-Lasprilla (2017)

3.6 Data Capturing, Management and Analysis

3.6.1 Data capturing and management

All the results from the tests conducted except the FPT were recorded on audiometry recording forms that contain sections with personal details and the different assessment results, see Appendix W. The FPT results are for data analysis therefore were recorded on a separate form with a participant number and no personal details, see Appendix C. The FPT results were all collated onto a Microsoft Excel spreadsheet by the researcher, the data was labelled using numbers and letters to remove participant identifying information (Human Research Committee, 2019). The sheet with personal details were locked away in a secure cupboard. All data from the research will be stored online by the research supervisor for a minimum of five years (SAMRC,

2018). After the five years the research supervisor will delete the electronic copies of results and participant information, all the hard copies will be shredded and disposed of.

3.6.2 Data Analysis

Data was analysed using SPSS version 26, with the threshold for the statistical significance set at p=0.05. The normality of the data was checked by examining Q-Q plots and the Shapiro Wilk test (Villasensor Alva & Gonzalez Estrada, 2009), the data showed a non-normal distribution. Generated data for objective 1 was analysed using the descriptive stats of mean, range, interquartile range and standard deviation (Trochim, 2000).

For objective 2, a one- sample t-test compared the FPT results in each age group to the American Bellis norm values. The data reported was calculated as the mean minus 2 standard deviations as this is what the Bellis norms report on. Given the small sample size, the data was all analysed (see table 8 and table 9) and then reanalysed with the outliers removed (see table 10 and 11). The outliers were one value for each of the left and the right descriptive for ages 8 and 11. Parametric tests were done as the Bellis norms are based on mean values and not medians to assess significance (Okeh, 2009). Independent sample t-tests done compared FPT results between English and IsiXhosa home language speakers, and between female and male participants. The analysis of the data was done by a statistician at the university.

3.7 Scientific Rigour

Reliability was ensured by back translating the translated instructions for age appropriateness and by giving all testers standardized instructions, an outline of case history questions and recording sheets for results these were discussed before testing started (Trochim, 2000). A meeting to discuss how the data collection process is to be carried out was held to ensure reliability between the testers. Participants received the test instructions in the language they are most comfortable with. To ensure reliability of the data collection process between the 3 testers the pilot study done on the 5 participants and was checked using the Cohen's Kappa statistic (McHugh, 2012), see Appendix X, the outcome for the pilot was discussed in the methodology section.

FPT has high sensitivity and specificity of 80% for cerebral lesions in assessment for CAPD and using the exclusion criteria will ensure the content validity. The accurately translated materials, calibrated equipment, a sound-proof booth and standard procedures with proven efficiency ensure construct validity of the tests in the study (Musiek, 1999; Trochim, 2000). The content validity of the data collection process and the data collected would be linked to the standardised protocol used for the collection, through the formation of a framework where a strict step by step process was followed which each participant regardless of which tester was administering the assessments for that session to maintain consistency and validity of the results obtained.

3.8 Ethical considerations

Information and Consent forms were sent out to all parents/ legal guardians of the learners. As part of autonomy, they were given an opportunity to ask questions and time to make the decision (Declaration of Helsinki, 2001; World Medical Association Declaration of Helsinki, 2013). The consent forms required both the parent/legal guardian and the learner to give assent to participate. Participants were free to withdraw from the study at any time without providing a reason. On the day of data collection, a parent/legal guardian had to accompany the learner and be present in the same room as the participant during the testing.

In giving justice they were treated in the same way and they were given the same opportunity of being part of the study sample if they fulfilled the inclusion and exclusion criteria (Declaration of Helsinki, 2001; World Medical Association Declaration of Helsinki, 2013). They each received R50 for transport and R10 for parking costs reimbursement and a snack which was the same for all participants (Declaration of Helsinki, 2001; World Medical Association Declaration of Helsinki, 2013). In addition, all participants had the option of requesting the final results from the study once it was complete.

To maintain confidentiality and privacy, the only individuals that had access to their results are the main researcher, the 2 research assistants and the research supervisors. The research assistants signed confidentiality agreements (see Appendix Y) before testing commenced. The participant had individual sessions for testing with no other participants present. As mentioned earlier all the results from testing were stored on a password protected laptop.

In line with non-maleficence participation in the study assessments are minimally invasive and had minimal physical and psychological risks to the participants, there were no risks to the legal guardian/parent of the participant or the researcher (Declaration of Helsinki, 2001; World Medical Association Declaration of Helsinki, 2013). The research assistants are qualified audiologists who are suitably trained to conduct the required testing in children. The participants received free audiological assessments as a benefit of participating in the study, there are no direct benefits from the FPT results. All testing was appointment based therefore participants did not share sessions. No personal information of the participants is published. Any abnormal results that were found during testing the participant was referred to the relevant professional for further assessment and management as mentioned above.

For beneficence the participants did not directly benefit from the research. The test results from the hearing assessment were shared with the participants.

CHAPTER 4: RESULTS

In this chapter the various results obtained in the study will be highlighted from the recruitment of participants to the description of the FPT test results. The results will be discussed in the following order i) Participant description; ii) Description of the generated norms; iii) Comparison of created norms with the Bellis norms; iv) Additional descriptions by home language and gender.

4.1 Participant description

During the data collection process 35 participants were screened. Of the 35, 26 participants met the study inclusion criteria. See tables 3- 6, for the specific participants' description of the 26 participants included in the study, where the numbers from each school, home language, sex and age are illustrated.

Table 3: Description of participant schools

Schools:	Cecil Road School	3
	Dryden Road School	5
	Groote Schuur Primary	8
	Rosebank Junior School	3
	Hillcrest Primary School	7
	Total:	26

Table 4: Description of participant Sex

Sex:	Male	7
	Female	19
	Total:	26

Table 5: Description of participant home language

Home Language:	Afrikaans	1
	English	17
	IsiXhosa	8
	Total:	26

Table 6: Description of participant age

Age:	8 years old	7
	9 years old	8
	10 years old	5
	11 years old	6
	Total:	26

Table 7, indicates the number of participants included and excluded in the study from the total that was recruited. Nine participants were excluded from the study. There were no participants excluded from the study due to outer and middle ear abnormalities such as occluding wax, foreign objects, bony growths, middle ear infections and ossicular chain pathologies were not found. Participants were excluded due to previous or current therapy from occupational therapy, speech therapy or psychology being attended, under-age for testing, having a current disorder (autism spectrum disorder) and neonatal risk factors noted.

Table 7: Description of participant status		
Study Status:	Included	26
	Excluded	9
	Total:	35

4.2 Description of created norms

Table 8, describes the collated data from the FPT test from the 26 participants. These norms address Aim 1, to develop age specific data. All 26 participant results obtained for the FPT were used for analysis, of the 26 participants 13 were referred for full CAPD diagnostic assessments as their results were abnormal according to the Bellis (1996) norms. From the data it can be seen that the mean values for the humming response mode are consistently higher than those for the verbal response mode bilaterally. This can be seen across all age groups. The mean values for the verbal response in the 8-year-old group is the lowest below 50%, this is followed by an increase in the mean values for the 9 -11-year-old groups, which are all similar in the range from 56%- 74,5%. For the hummed response there is a slight increase in the mean values noted in the right ear for ages 8, 9 and 11. The overall scores for the hummed response ranged from 85.3%-95%.

It was noted that in the results for the age groups 8, 9 and 11 there were some participants that did not complete the verbal section of the assessment, this occurred as some of the participant could not comprehend how to respond verbally by attaching a label to the sounds heard. Once they had to hum the response they were able to perform the task as required. For both the verbal and the hummed responses it was noted that the standard deviations are large, this can be explained by the small sample size in each group as well as the outliers in the in the data for age groups 8 and 11.

Table 8. Initial Descriptive Statistics for the Frequency Patterns Test by Age Group

		n	Mean	SD	Range	Median	IQR
Age 8							
	R Verbal	5	40.0	28.7	13.3 - 86.7	26.7	20 – 66.7
	R Humming	7	91.6	7.3	80 – 100	93.3	86.7 – 100
	L Verbal	5	29.3	33.2	6.7 – 86.7	20.0	6.7 – 56.7
	L Humming	7	85.9	19.8	46.7 - 100	93.3	73.3 - 100
Age 9							
	R Verbal	7	66.7	28.5	27 – 93.3	80.0	33.3 – 93.3
	R Humming	8	95.0	9.3	73.3 – 100	100.0	93.3 – 100
	L Verbal	6	74.5	22.1	46.7 – 93.3	83.5	46.7 – 93.3
	L Humming	8	92.5	10.9	66.7 - 100	93.3	93.1 - 100
Age 10							
	R Verbal	5	61.3	28.4	20 - 86.7	66.7	33.3 – 86.7
	R Humming	5	85.3	15.2	66.7 – 100	86.7	70 – 100
	L Verbal	5	68.0	22.3	33.3 – 93.3	66.7	50 – 86.7
	L Humming	5	88.0	11.0	73.3 - 100	93.3	76.7 – 96.7
Age 11							
	R Verbal	5	60.0	35.0	13.3 – 100	60.0	26.7 – 93.3
	R Humming	6	94.5	13.6	66.7 – 100	100.0	91.7 - 100
	L Verbal	5	56.0	33.5	13.3 – 93.3	46.7	26.7 - 90
	L Humming	6	92.2	13.0	66.7 - 100	96.7	86.7 - 100
Total							
	R Verbal	22	57.9	29.7	13.3 - 100	56.7	26.9 – 86.7
	R Humming	26	92.1	11.1	66.7 – 100	100.0	86.7 – 100
	L Verbal	21	57.8	31.3	6.7 – 93.3	66.7	30 – 86.8
	L Humming	26	89.8	13.7	46.7 - 100	93.3	85.7 - 100

Table 9, an additional analysis and comparison (see table 11) of the FPT results was done following removal of 4 outlier values found. One value was removed in both the left and right verbal responses of age groups 8 and 11. Following the removal of the outlier values the mean values have decreased from 40% to 28.3% in the right ear and from 29.3% to 15% in the left ear, and standard deviations have decreased from 28.7% to 13.7% in the right ear and from 33.2% to 9.9% in the left ear for the 8 year old age group. In the 11-year-old age group it can be noted that the mean values increased from 60 % to 71.7% in the right ear and from 56% to 66.7% in the left ear, and a decrease in the standard deviation values from 35% to 26.9% in the right ear and from 33.5% to 27.2% in the left ear.

Table 9. Final Descriptive Statistics for the Frequency Patterns Test by Age Group

		n	Mean	SD	Range	Median	IQR
Age 8							
	R Verbal	4	28.3	13.7	13.3 – 46.7	26.7	16.7 – 41.7
	R Humming	7	91.6	7.3	80 – 100	93.3	86.7 – 100
	L Verbal	4	15.0	9.9	6.7 – 26.7	13.3	6.7 – 25.0
	L Humming	7	85.9	19.8	46.7 - 100	93.3	73.3 - 100
Age 9							
	R Verbal	7	66.7	28.5	27 – 93.3	80.0	33.3 – 93.3
	R Humming	8	95.0	9.3	73.3 – 100	100.0	93.3 – 100
	L Verbal	6	74.5	22.1	46.7 – 93.3	83.5	46.7 – 93.3
	L Humming	8	92.5	10.9	66.7 - 100	93.3	93.1 - 100
Age 10							
	R Verbal	5	61.3	28.4	20 - 86.7	66.7	33.3 – 86.7
	R Humming	5	85.3	15.2	66.7 – 100	86.7	70 – 100
	L Verbal	5	68.0	22.3	33.3 – 93.3	66.7	50 – 86.7
	L Humming	5	88.0	11.0	73.3 - 100	93.3	76.7 – 96.7
Age 11							
	R Verbal	4	71.7	26.9	40 - 100	73.3	45.0 - 96.7
	R Humming	6	94.5	13.6	66.7 – 100	100.0	91.7 - 100
	L Verbal	4	66.7	27.2	40 – 93.3	66.7	41.7 – 91.7
	L Humming	6	92.2	13.0	66.7 - 100	96.7	86.7 - 100
Total							
	R Verbal	20	58.7	28.7	13.3 - 100	56.7	28.6 – 86.7
	R Humming	26	92.1	11.1	66.7 – 100	100.0	86.7 – 100
	L Verbal	19	58.6	30.5	6.7 – 93.3	66.7	33.3 – 87.0
	L Humming	26	89.8	13.7	46.7 - 100	93.3	85.7 - 100

4.3 Comparison between created norms and Bellis norms

Table 10 shows the comparison of the FPT results obtained in this study to the Bellis (2003) norms, to address Aim 2. There were statistically significant differences between the verbal responses of this study and the Bellis Norms for both the left and right ears with these the newly generated data responses being significantly lower across all the age groups. It was noted that the values for the 8-year-old and 11 year old groups were in the negative. This occurred due to the outliers found in these two groups and the large standard deviations. For the humming response in the right ear, the newly generated data values were significantly higher than the Bellis Norms for ages 8 and 9, and significantly lower for age 10 and 11. Although there was no statistical significance found the difference in scores for the 11-year-old age group. In the values noted for the left ear were also higher for the ages 8 and 9, and lower for the ages 10 and 11 when compared to the Bellis norms however, there was not statistical significance found in the differences.

Table 10. Initial Comparison of the Frequency Patterns Test to American-Bellis Norms

Age (years)	Bellis Norms		Verbal				Humming			
	R	L	R	*p*	L	*p*	R	*p*	L	*p*
8	42	42	-17.4	.010*	-37.1	.006**	77	<.001**	46.3	.590
9	63	63	9.7	.003**	30.3	.015*	76.4	.005**	70.7	.088
10	78	78	4.5	.004**	23.4	.005**	54.9	.027*	66	.070
11	78	78	-10	.005**	-11	.004**	67.3	.111	66.0	.076

Note. Means are presented. These values represent the mean minus 2 SDs as per the Bellis norms.

Table 11, Following the removal of the outliers in both the left and right verbal responses it was noted that the Mean- 2SD value for the age groups 8 and 11 were no longer negative values. Despite this change there are consistent significant differences between the description variables and the Bellis Norms for both the left and right ears in all age groups. For the hummed responses, no changes were made as no outliers were found.

Table 11. Final Comparison of the Frequency Patterns Test to American Bellis Norms

Age (years)	Bellis Norms		Verbal				Humming			
	R	L	R	*p*	L	*p*	R	*p*	L	*p*
8	42	42	0.9	.009**	8.5	.017*	77	<.001**	46.3	.590
9	63	63	9.7	.003**	30.3	.015*	76.4	.005**	70.7	.088
10	78	78	4.5	.004**	23.4	.005**	54.9	.027*	66	.070
11	78	78	17.9	.021*	12.3	.017*	67.3	.111	66.0	.076

Note. Means are presented. These values represent the mean minus 2 SDs as per the Bellis norms.

4.4 Additional descriptors- Home language and gender

Table 12, revealed a comparison of the means between the English home language speakers and IsiXhosa home language speakers, there was not a sufficient number of Afrikaans speakers in the study for the comparison. There was 1 Afrikaans speaker in the study. The results revealed that the English language speakers performed better than the IsiXhosa language speakers when verbal responses were used in the test. For the hummed response the mean values were similar for both language speakers bilaterally.

Table 12. Frequency Patterns Test by Home Language *t*

	Home Language	N	Mean	SD	*t*	*p*
R Verbal	English	15	68.0	27.4	2.42	.026*
	Xhosa	6	36.7	25.2		
R Humming	English	17	90.3	12.5	-0.98	.336
	Xhosa	8	95.0	7.8		
L Verbal	English	14	69.5	26.9	2.77	.013*
	Xhosa	6	32.3	29.2		
L Humming	English	17	90.6	11.8	0.52	.606
	Xhosa	8	87.5	18.7		

Table 13, shows the comparison of results by gender. The male participants performed better than female participants in both verbal and humming response modes. However, the difference

was more marked in the verbal response mode. These differences were not statistically significant.

Table 13. Frequency Patterns Test by Gender

	Sex	N	Mean	SD	*t*	*p*
R Verbal	Female	16	52.9	30.3	-1.31	.207
	Male	6	71.2	25.8		
R Humming	Female	19	91.3	11.7	-0.60	.553
	Male	7	94.3	9.8		
L Verbal	Female	16	51.3	32.0	-1.81	.086
	Male	5	78.7	18.5		
L Humming	Female	19	86.7	14.9	-1.97	.061
	Male	7	98.0	3.3		

CHAPTER 5: DISCUSSION

This study aimed, to firstly develop age specific normative data for the FPT in South African children aged 8-11 years old and secondly, to compare the current study normative data to the Bellis' normative data. This section will discuss the findings from both aims in relation to the relevant literature. In addition, this chapter includes a discussion of the implications of the study findings for future research and practice in the field of CAPD in SA, as well as a description of the study limitations.

5.1 Participant Description

The participants were recruited from schools with a similar socio-economic ranking. This was categorized by the quintile ranking of the schools, where four are in the 5th quintile and one is fully private. This ranking of the schools gives an idea of the families in the community which the school services and subsequently of the participants. The participants were predominantly English first language speakers and is not representative of the general South African population where majority of the population are not English first language speakers. This demographic noted in the study may be due to the participants being recruited from schools that are similar in a suburban area of the Cape Town Metropole, with an indication of the communities that surround them.

It is noted there are recent studies that have included participants that are 7 years old (Mattsson et al., 2018). The study by Mattsson et al., (2018) included participants from the age of 7-years-old, as learners are taught English from this age at school in the Netherlands. This current study did not include this age group in hopes to meet both aims using the same data. For aim 2 to be met a comparison with the American-Bellis norms was done, these norms do not include the 7-year-old group, therefore would not have a reference to compare the data to.

5.2 Developing age specific normative data for the FPT in SA children aged 8-11 years.

Aim 1, was to develop age specific normative data for the FPT in South African children aged 8-11 years. The data obtained from the 26 participants was in two sets, for the verbal response and the hummed response, see table 8. Overall, the results showed a better performance in the

humming response than the verbal response across all age groups bilaterally. The values for the hummed response ranged from 85.3%- 95%, which are significantly higher than those of the verbal description which range from 29.3%-74.5%. The same trend can be seen in the SA study discussed earlier which was conducted by Campbell and Wilson (2003) in children aged 8-10 years old. The results from their study showed higher hummed response values than those of the verbal responses as well. It is therefore helpful to have a distinction of results for the two response modes in the S.A context.

This highlights better processing performance of the stimuli in the right hemisphere as only this hemisphere is required in processing the stimulus for a hummed response (Musiek, 1994). As mentioned in the introduction, the right hemisphere is responsible for the processing of musical and acoustic contours without the need for interhemispheric transfer (Bellis, 2011). In addition, the differences seen in the response modes may give an indication of the maturity of the corpus callosum and its current processing ability (Bellis, 2011). This is attributed to it being required for interhemispheric transfer of information to process and attach verbal labels to the stimulus tones in the left hemisphere (Bellis, 2011). During assessment it was revealed that the participants were struggling with the verbal aspect of the assessment. The number of responses obtained in the 8-year-old group and 9-year-old group for the two response modes are different however, for the 10 and 11 year olds they are consistent. For the 8-year-olds, 5 verbal responses were obtained and 7 hummed responses, for the 9-year-olds, 6-7 verbal responses and 8 hummed responses were obtained. In addition, outliers were found in the analysis of the data for the verbal response for the ages 8 and 11 groups. This raises questions as to why fewer verbal responses were obtained for the younger participants. These results may be due to trouble comprehending the task required of them or it may be reluctance to speak to the tester. During testing, one of the younger participants struggled with the English verbal responses for the test, after further discussion with her she chose to change and respond verbally in IsiXhosa which showed a big improvement in her response scores. Firstly, this highlighted the test adaptability of the FPT. With no linguistic load in the test itself, it allows for the test to be administered in a language the patient is most comfortable in without changing the integrity of the assessment. Secondly, the language the test is administered in affects tests scores due to it working with the comprehension and how confident/ comfortable the patient is with responding verbally. In retrospect, in addition to ensuring the participants are responding to the assessment in a comfortable language it is important to build a good rapport with the participant especially the younger learners. This rapport would allow them to ask questions for clarity and give them the opportunity to participate more freely even

with the general anxieties of taking assessments. In the introduction, the diversity of spoken languages in the South African context was highlighted. Although the FPT is not affected by language, the mismatch between the language the clinician uses to administer the test and the language the patient is comfortable with may have unwanted effects on the results obtained and remains a challenge.

The findings of the study when comparing how the first language English speakers and how the first language IsiXhosa speakers performed show that both groups performed better in their hummed response than the verbal response. In addition, the first language English speakers performed better in their verbal responses bilaterally and better in the left hummed response. Once again, the language in which the test is administered and how the participants are allowed to respond makes a difference in the results obtained from the assessment (Saleh, Campbell & Wilson, 2003). All participants were allowed and given the choice of the language they were most comfortable with and wanted the assessment to be conducted in. The fear and uncertainty of the testing process may have led to some participants not speaking up, which was seen with one participant changing her language of assessment once she was given the choice again during testing. In clinical practice to overcome this challenge of administering the test in the patients' preferred language pre-recorded instructions may be used in the case where the clinician is unable to speak the requested language.

As mentioned above there were outliers found in the analysis of the verbal responses for the 8 year old and 11 year old age groups. According to Trochim (2000) these outliers in the data may have a significant effect on the mean and standard deviation (SD) values for both the right and left ears which it was seen in the analysis. To overcome this a second analysis was done on the data (see table 9) which noted a significant change in the mean and SD values, with the greatest change seen in the 8 year old groups values changing from mean values 40% to 28.3% in the right ear and from 29.3% to 15% in the left ear, and SD values of 28.7% to 13.7% in the right ear and from 33.2% to 9.9% in the left ear. This indicated that the difference in the range of scores for this younger group was more substantial or significant than the differences in the 11 year old group. In addition, the SD values are generally smaller in the hummed response than in the verbal response, with a range from 7.3%- 19.8% in the hummed responses and from 9.9%-30.5% in the verbal responses. These themes allude to the stabilization of the abilities and neuromaturation of the CANS as it develops, this will be discussed further below.

Another key finding in the test scores was the difference in mean values for the participants in the 8-year-old range when compared to the older participants. The tests scores showed improvement as the children get older. This finding illustrates the effect of neuromaturation on the individual's processing ability. The theme that emerges is the growth in the processing ability of the children as they get older. This was a common there in the results from the Bellis (1996, 2003) studies, the Kelly (2007) study as well as the Campbell and Wilson (2003) study. Similarly in this current study, when the children get older, their processing ability of the stimulus tones improved, in both the hummed response and the verbal response. This links back to neuromaturation of the CANS. As discussed in the literature review, the CANS develops in stages and continues to mature as the child grows into an adolescent and young adult. The first areas to develop myelination and mature are the structures of the brainstem (Bellis, 2011). The areas for cortical communication such as the corpus callosum mature later allowing for the auditory system to work more efficiently with the inter and intra-hemispheric transfer of the auditory stimulus needed in the FPT (Bellis, 2011). A study by Rezakolaei, Mahdavi and Tabatabaee (2018), noted the same trend of results improving with age in their assessments of the Persian Pediatric Competing Words and Persian Randomized Dichotic Digit tests. The children's scores increased with age regardless of their gender and handedness (Rezakolaei et al., 2018).

The mean values for the verbal response in the 8-year-old group is the lowest below 50, this is followed by a big jump in the 9 -11 year olds with mean values which are all similar in the range of 56%-74.5%. There is no sign of a right ear advantage (REA) in the verbal responses across all ages. For the hummed response there is a slight increase in the mean values for ages 8, 9 and 11. Although, there is this minimal difference between the ears' scores in the hummed response, it is still not significant enough to be considered a REA. This is consistent with how the processing of the FPT takes place in the brain (Musiek, 1994; Shinn, 2007; Bellis, 2011). The tonal nature of the FPT stimulus means that it needs to go through the right hemisphere first for processing as mentioned in the literature review (Musiek, 1994; Shinn, 2007; Bellis, 2011). The REA is frequently seen in assessments that have a linguistic load to process, the more linguistically loaded a test is the greater the REA seen (Bellis, 2011). This occurs as a result of the tests being processed in the left hemisphere which is dominant for processing speech and language stimuli (Musiek, 1994). As such, a REA is not expected in the research findings of this study. In a study by Mattsson et al., (2018) they found that there was no REA for the FPT, the scores for the left ear were better only for the dichotic digits, competing words and the filtered words tests (Mattsson, 2018). In the Bellis norms (1996, 2003) and the Campbell and Wilson (2003) studies, the REA is

not recorded. However, the Kelly (2007) study did record a small REA for the 8-year-old group which disappeared into the 9 and 10 year old groups. Therefore, either the REA has not been noted or has been minimally noted in the different studies mentioned above, however it cannot be confirmed in this study.

Lastly, regarding the results by gender. It was noted that the male participants' results were higher than those of the female participants', this was seen more in the verbal response. Though these differences are present, they do not have statistical significance. The lack of gender effects on the results is consistent with reports from other studies (Fuente & McPherson, 2006; Majak, et al., 2015; Mattsson et al., 2017; Rezakolaei, Mahdavi & Tabatabaee, 2017).

The findings from the data discussed under aim 1 meet the need for age specific normative data. This was achieved by generating a dataset from South African children in the Western Cape, Cape Town metropole. The findings have shown varied results across the age groups which is a reflection of the neural growth seen in the test population as well as their performance in the assessment. This aim was partially achieved as the test findings are not representative of the population of South African children as a whole and the sample size was small therefore the themes and trends found in these results need to be viewed conservatively.

5.3 Comparison between created norms and Bellis norms

As highlighted in the methodology section aim 2 is to determine the relationship between existing American-Bellis normative data and the newly generated South African normative data, the comparison can be seen in Table 10 and 11. For this comparison the Bellis norms (2003) have been used, this was as per the South African CAPD taskforce recommendation to use the Bellis (1996) test protocol (Saleh, Campbell & Wilson, 2003). The Bellis protocol is also the most widely used protocol (Campbell & Wilson, 2003; Saleh, Campbell & Wilson, 2003; Fuente & McPherson, 2006; Kelly, 2007). The comparison found that there were statistically significant differences between the mean values obtained for the verbal response mode in this study and the mean values specified in the Bellis norms for both the left and right ears. In the initial comparison large standard deviations in the 8 and 9 year old groups verbal responses affected the analysis as negative values for the mean-2SD were generated. To overcome this a secondary analysis was done after removing outliers and the mean-2SD values were appropriate for comparison between

the two populations. The newly generated normative data for verbal responses revealed significantly lower results than the American-Bellis norms for the verbal responses. The differences were lower in the right ear responses than the left ear for age 8, 9 and 10 groups and the reverse for the 11 year old group.

When the newly generated results for the humming values are compared to the values of the American-Bellis norms, the newly generated values are higher in the 8 and 9 year old age groups bilaterally, with a significant difference only seen in the right ear. When looking at the 11 year old group the hummed results were lower than the American-Bellis norms and these differences were not statistically significant for both the right and left ears. It has been long established that the hummed response tends to have better results than the verbal response (Musiek, 1994; Bellis, 2011; Bellis & Bellis 2015). As this may be the case, this does not explain the difference in the hummed values between the populations, as no language variables are present in the stimulus and the response. It is important to note that the linguistic load that is on many of the CAPD assessments may not be present for the FPT as previously discussed however, in the synthesis of the results from the comparison between the two populations a significant difference is seen in both the verbal and hummed responses, with only the left ear hummed responses being non-statistically significant. The statistical significance of the differences in the results remained the same for both verbal and hummed responses following the second analysis.

Further research into the reasons as to why South African children perform at varied levels for the hummed response would assist in understanding the processing differences in the populations as well as across age groups. The comparison of the two data sets meets aim 2 of this study in describing the differences and similarities between the two populations. These differences found further confirm the importance of developing context specific data. The research question of: Are the scores for the FPT in South African children different to those of American children? Was answered, from the results and the comparison of the two data sets it revealed that the scores between the two populations are different.

CHAPTER 6: CONCLUSION

This study aimed to firstly, create age specific normative data for South African. children aged 8-11 and secondly, to compare the American-Bellis norms with the newly created data. A process to the method of normative data development was well defined. The study was able to create a data set with norms from 26 participants ranging from 8- 11 years old. In describing the population assessed and creating the data set, aim 1 was met. While the tonal stimuli of the FPT minimizes the influence of language on test performance, the study findings confirmed that test performance may be affected by the language of test instructions and response. In the South African context this would continue to be a challenge due to the language diversity. If there is a mismatch between the language of instruction the clinician uses and the language a patient is most comfortable with.

The findings reiterate that age specific data is an important characteristic that normative data should have. Each age group had results specific to that group with the score improved with age. This brought to light the understanding of how processing abilities mature as the child grows. The maturing of the auditory pathways in the CANS was seen in the processing of the hummed response and the verbal response, where the hummed responses were higher than the verbal responses bilaterally and across all the age groups. It was highlighted that the REA is not a trend that is expected from an assessment such as the FPT due to the processing mechanism that it has.

Aim 2 was met through the comparison of the Bellis norms and the created normative data set. The comparison was in agreement with previous reports highlighting the differences in the data sets from the two contexts. The verbal responses from the two groups had a significant difference between them. The differences in the hummed response were significantly higher in the hummed responses from the younger participants and lower in the older participants in the South African data set.

Some of the recommendations highlighted in this study were made by the South African CAPD taskforce approximately 20 years ago. Limited progress has since been made in developing the field of CAPD for the South African context. This study could not show the applicability of the FPT and the low linguistic load of the test. However, this study may contribute to the growing body of work aimed at contextualising CAPD assessments and addressing challenges that are faced

within this specialized field in S.A. As mentioned above, the data set that was developed was created from a small sample size therefore, the findings cannot be generalized outside of the group of participants assessed and no final conclusions broader practice can be drawn from the data set. In addition, the results from the study then also need to be interpreted with caution. It is hoped that this study will be the first step in research for normative data development, will prompt bigger studies and further research in the development of normative data for the SA context in the assessments for CAPD.

CHAPTER 7: IMPLICATIONS AND RECOMMENDATIONS OF THE STUDY

7.1 Implications for CAPD assessment in S.A.

One of the biggest challenges in the South African context with CAPD is the language barrier experienced with the language used by the clinician for administering the assessment and with the assessment itself. Additionally, a lack of test materials in South African languages as well as accents, despite reported information that language along with accents play a significant role on test performance and results.

The results from the study could not show that the FPT is an assessment that is not affected by language and as an appropriate choice of assessment for a context with linguistic diversity such as S.A. It has previously been established that the test has a low linguistic load, thus reducing the impact of language on test performance, it was noted that in younger children the language of instruction and response may affect the results. It remains a challenge when majority of the current clinicians only speak English or Afrikaans and will continue to be a challenge as the mismatch in language between clinician and patient continues in practice (Pascoe & Norman, 2011; Statistics South Africa, 2014; Pillay et al., 2020).

There is value in having the FPT included in the CAPD diagnostic test battery and screening battery. The findings of the study further confirm the need to continue building research in the appropriateness of including the FPT in a low linguistically loaded test battery in the South African context. The applicability of the assessment begins to clarify and build on the recommendation of the South African CAPD taskforce by adding clear direction in what should be included in the test battery. The simplicity of administrating the assessment and the specificity of finding the site of lesion show the applicability in the South African context. This is important as there are not sufficient resources nor time and is exacerbated by limited resources allocated to the assessment and management of specialized communication disorders. Thus, appropriate assessment practices and guidelines are important so as not to waste resources on misdiagnosis and mismanagement.

In having guidelines, the hope is to build more confidence in clinicians to assess and manage CAPD in the South African context. Coupled with a step in the right direction regarding test applicability, the findings are in agreement with the development of normative data that is not only

context specific, but age specific as well (Noffsinger, Wilson, Musiek, 1994; Campbell & Wilson, 2003; Saleh, Campbell & Wilson, 2003; Kelly 2007, Mattsson et al., 2018). The data set obtained continues to show that there are differences between normative data from the American-Bellis norms and norms from the South African context. This applies to the norms for each age group and the separation of these groups highlights the various stages of processing development of children, therefore separating them allows for a more accurate diagnosis.

In a broader view of the status of CAPD in S.A these findings are a first step towards building context specific normative data using a defined step by step process. The process defined in this study was simple to follow and allowed for the appropriate preparation of what would be required in the collection of data and creating a set of normative data. Adequate time needs to be allocated for each step in the process with more time being allocated to the recruitment, screening and assessment stages. To build on this study and continue to build South African resource materials, a study that includes a representative sample would be vital and a necessary step to having data that is generalizable to the entire country and can be used in the diagnosis process. For the advancement of the status of CAPD in S.A., larger scale studies need to be done on the different assessments in the Low-linguistically loaded test battery by adapting the assessments for the context and creating normative data.

7.2 Limitations

The study had a few limitations. These may assist any future research in the development of South African normative data in the area of CAPD. Firstly, the study sample may not be representative of the greater Cape Town area as the 5 schools in which the participants were recruited were in one area which possibly means that the participants may have had similar home backgrounds, learning environment and socioeconomic status as alluded to by the type (quintiles) of schools they were recruited from. Due to minimal funds the study could not provide transport for individuals from schools far from the university for the assessments therefore limiting the reach area of the study. As mentioned, this would then affect the diversity of the sample recruited for the study, preventing it from being generalized to the greater Cape Town area. For future studies accounting for traveling expenses and logistical plans for participants who live further away would assist in overcoming this limitation.

Secondly, the number of participants that were recruited for assessment was 35 and the subsequent sample size was 26, much less than the required size of 110 which affected the analysis of the data. The number of participants recruited was low even with the incentives mentioned in the research procedure offered. The reasons for the small sample size are primarily related to the COVID-19 pandemic. Parents were hesitant to join the study in fear that the research was connected to the pandemic. Others withdrew participation in fear of contracting the Corona virus and some had concerns when it was clarified that the data collection was being conducted in a hospital setting. Only 5 participants were used for the inter-rater reliability, which yielded 20 sets of data to calculate the level of agreement on. The researcher and the research assistants' level of agreement was substantial at 0.76 which is seen as good. However, for research in health care it is recommended that a minimum agreement of 0.8 is better. Therefore, with more time and an increased number of participants used for the reliability calculation, the level of agreement may have been higher. It has been noted that the small number of participants affected the statistical power of the data set. In addition, this mean that the data from this study cannot be generalized to the Western Cape population and the greater South African population. Future studies should consider in the timeline of their study the possibility of extending the recruitment period to sample more of the populations and evaluate recruitment strategies as well as extend the data collection period to compensate for low participant numbers.

Thirdly, participant attendance was generally poor after participants agreed to participate in the study. In addition, six participants fell ill before their assessment date and could not attend, these participants are not included in the 35 that were screened with audiological tests. During the last weeks of data collection there was Taxi violence in and around the Cape Town area which affected many people by preventing them from getting to work and other places, this meant that one participant was not able to reach the testing site. This included preventing some of the participants from attending their assessment session even after it was rescheduled. There was no transport offered by the study to attend the assessment session, participants had to make their own way to the sessions. This meant that attending the session was then solely the responsibility of the participant and their parents/guardian. The poor attendance of the participants affected the study sample size which meant that in addition to recruiting a small number the sample size was decreased again. The small sample affects the analysis of the data directly, in that the data variability is greater and no conclusions can be drawn from the data obtained. In attempting to overcome this limitation future study should consider providing transportation to the testing venue leaving only the responsibility of the participant to avail themselves for the session.

There were minimal resources in the form of funds, and time constraints that were a limitation to the study. More funds and time would have allowed for a better representative sample of schools from different sub-districts in the Cape Town Metropole as participants from areas further from the university would have been reached. As well as the opportunity to recruit and assess more participants. A greater pool of diverse participants would have been assessed or screened, giving the study more participants to include in the final analysis. The lack of funding for significant incentives (besides paying for parking and refreshments for the participants) to possibly improve attendance would have made a difference in the sample size. The time constraints due to the national lockdown restrictions affected the recruitment and data collection within the approved study period. Obtaining a substantial amount of funding for the study would assist in ensuring that the study is able to function optimally.

7.3 Study recommendations

- The findings of this study revealed promising results from the FPT as an assessment that is contextually relevant to be used in the South African context.

- The process of generating normative data adapted for this study provides a replicable step by step process that may be applied to other studies to generate context-specific normative data for CAP tests. In the event that test materials need to be re-recorded first, a different process would need to be used in the initial stages of the study followed by the process outlined in this study to generate the normative data for the test.

- This study has confirmed the need for not only context specific normative data, but for age specific data. This is important to consider when developing normative data.

- The scale of the study of normative data produced is not sufficient to be used and generalized to the greater South African context therefore, the data from this study would be best used as a first step to creating a full normative data set that is representative of the country's population.

Expected outputs

Once the study is complete, the expected outputs would be to publish the work in a local South African Journal and if opportunity arises in an international journal as well. To further disseminate the work of the study by presenting the work at conferences of key members that play a part in the development of CAPD such as: Audiologists, Speech therapists, ENT specialists and Department of Health.

Conflicts of Interest

There are no conflicts of interest in this study.

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Appendices

Appendix A

CAPD assessment categories

Assessment category	Tests	Process assessed
Monaural low redundancy	-Low pass filtered speech -Time compressed speech -Speech in noise test -Time compressed with reverberation	Auditory closure, Auditory discrimination
Temporal processing	-Frequency pattern test -Duration pattern test -Psychoacoustic pattern discrimination test	Auditory discrimination, Temporal processing, Temporal ordering
Dichotic listening	-2 pair Dichotic digits' test -Staggered spondaic word test -Synthetic sentence identification test -Dichotic speech identification test -Dichotic consonant vowel test -Competing sentence test -SCAN -Dichotic rhyme test	Binaural integration, Binaural separation, Auditory discrimination
Binaural interaction	-Band pass filtered binaural fusion test -CVC binaural fusion test -Interaural just noticeable differences test	Binaural interaction, Auditory discrimination

Table. *Illustrates the four assessment categories included in CAPD testing battery. The table shows the different tests that fall under each category and the different auditory processes that are assessed within the categories*.

Appendix B

Contents of the VA-CD Tonal and Speech Materials for Auditory Perceptual Assessment, Disc 1.0

Track/Time (Min/Sec)	Channel'	Content
01/ (0 :32)	L	1000-Hz calibration tone
	R	1000-Hz calibration tone
02/ (5 :18)	L	Spondees, S .N . masking-level difference (MILD)
	R	Spondees, S .N . masking-level difference (MILD)
03/ (4 :56)	L	Dichotic synthetic musical chords
	R	Dichotic synthetic musical chords
04/ (4:57)	L	Dichotic chords with 90-msec onset lag
	R	Dichotic synthetic musical chords
05/ (3:02)	L	Dichotic nonsense syllables (CVs)
	R	Dichotic nonsense syllables (CVs)
06/ (3:04)	L	Dichotic syllables with 90-msec onset lag
	R	Dichotic nonsense syllables (CVs)
07/ (3:39)	L	Dichotic monosyllabic digits
	R	Dichotic monosyllabic digits
08/ (4:59)	L	Dichotic synthetic sentences
	R	Dichotic synthetic sentences
09/ (3:54)	L	VIOECITO-consonant segments (CNCs), list 5A
	R	VIOECITO-consonant segments (CNCs), list 5A
10/ (3 :55)	L	VIOECITO-consonant segments (CNCs), list 5B
	R	VIOECITO-consonant segments (CNCs), list 5B
11/ (4 :00)	L	NU #6, high-pass filtered, list 3C
	R	NU #6, high-pass filtered, list 3C
12/ (4 :04)	L	NU #6, high-pass filtered, list 4C
	R	NU #6, high-pass filtered, list 4C
13/ (7 :03)	L	Frequency tonal patterns
	R	Duration tonal patterns
14/ (3:59)	L	NU #6, 45% compressed, 0.3-sec reverb, list 5
	R	NU #6, 45% time-compressed, list 5
15/ (4:01)	L	NU #6, 45% compressed, 0.3-sec reverb, list 6
	R	NU #6, 45% time-compressed, list 6
16/(4:02)	L	NU #6, 65% compressed, 0 .3-sec reverb, list 7
	R	NU #6, 65% time-compressed, list 7
17/ (4:02)	L	NU #6, 65% compressed, 0 .3-sec reverb, list 8
	R	NU #6, 65% time-compressed, list 8
18/ (0:18)	L	100-Hz, pulsed phase calibration tone
	R	100-Hz, pulsed phase calibration tone

***L = left, R = right. Note that "Left Channel" and "Channel 1" are used interchangeably in the text and in accompanying instructions the VA-CD.** (Noffsinger, Wilson & Musiek, 1994).

Appendix C

Frequency Patterns test response Sheet

Frequency Patterns test- Track 21							
Right	**Stimulus**	**Verbal**	**Humming**	**Left**	**Stimulus**	**Verbal**	**Humming**
1	**LLH**			**16**	**LHH**		
2	**LHH**			**17**	**HLL**		
3	**HLL**			**18**	**LLH**		
4	**HHL**			**19**	**HHL**		
5	**HLH**			**20**	**LLH**		
6	**LHL**			**21**	**LHL**		
7	**LHH**			**22**	**HLH**		
8	**LLH**			**23**	**LHH**		
9	**HHL**			**24**	**HLL**		
10	**HLH**			**25**	**LLH**		
11	**LHL**			**26**	**HLL**		
12	**HLL**			**27**	**LHL**		
13	**HHL**			**28**	**LHH**		
14	**LHL**			**29**	**HHL**		
15	**HLH**			**30**	**HLH**		

Key

L- Low

H- High

Appendix D

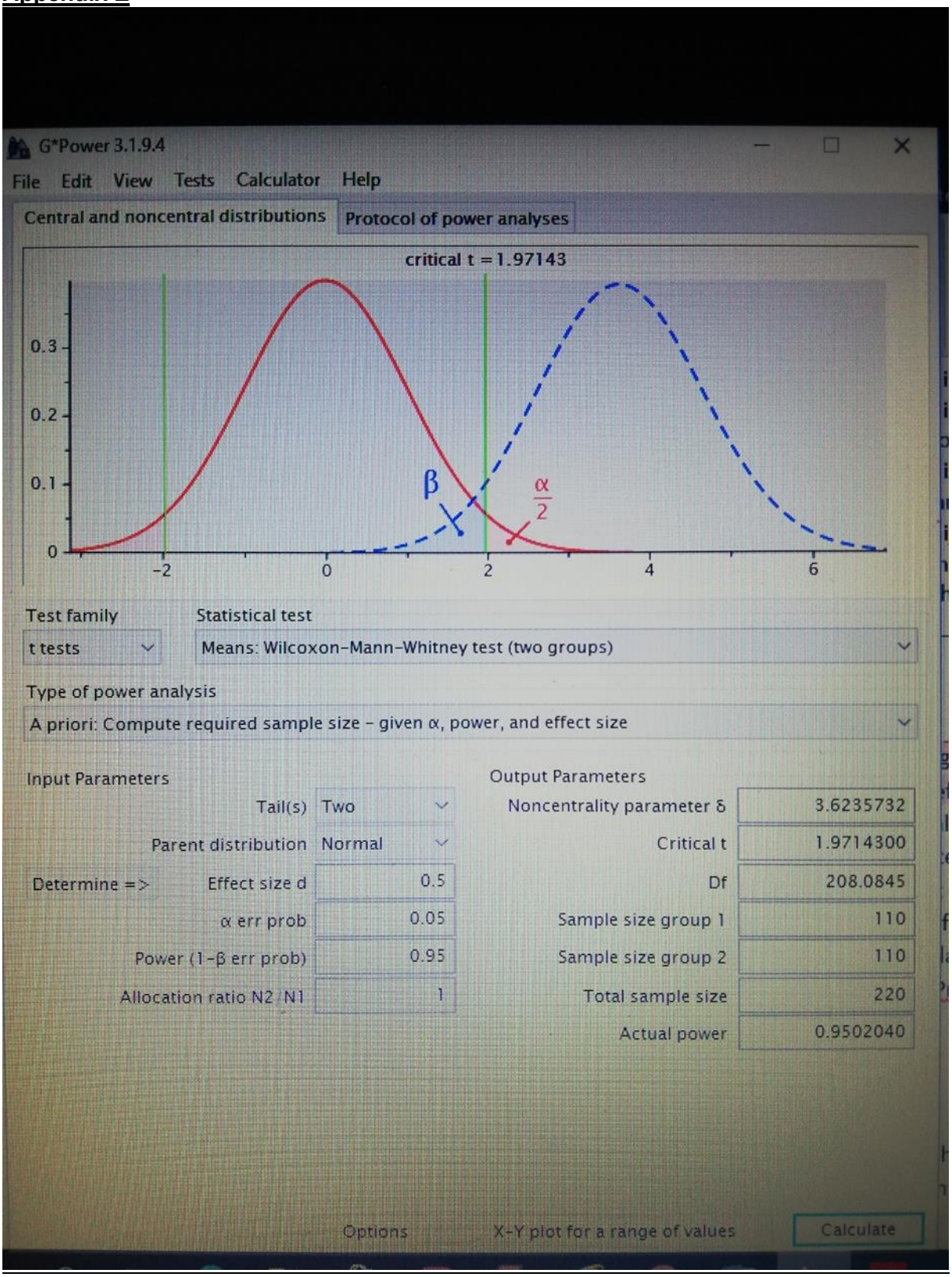
Table 2: SA English first language speaking child data (mean ± SD and mean - 2SD), and Bellis' (1996, 2003) American Normative data (mean - 2SD only, in bold)

Age in years	Test	Dichotic digits test		Frequency pattern test - verbal		Frequency pattern test humming		Low-pass filtered speech		Speech MLD test (dB)
	Ear	R (%)	L (%)	R (%)	L (%)	R (%)	L (%)	R (%)	L (%)	
8 (n=10)	Mean ± SD	87.0 ± 7.5	77.3 ± 8.8	49.4 ± 14.5	50.2 ± 12.9	56.8 ± 8.8	56.4 ± 9.7	43.5 ± 13.1	37.5 ± 15.5	5.2 ± 1.1
	Mean-2SD	71.9	59.7	20.4	24.5	39.2	37.0	17.2	6.5	2.9
	Bellis	**75**	**65**	**42**	**42**	**42**	**42**	**70**	**70**	**5.5**
9 (n=10)	Mean ± SD	88.0 ± 7.4	82.0 ± 7.9	64.0 ± 9.6	64.0 ± 7.7	67.2 ± 6.2	68.2 ± 6.3	49.5 ± 9.3	50.5 ± 12.6	5.8 ± 0.8
	Mean-2SD	73.1	66.2	44.9	49.1	54.8	55.6	31.0	25.4	4.1
	Bellis	**80**	**75**	**63**	**63**	**63**	**63**	**68**	**68**	**5.5**
10 (n=10)	Mean ± SD	93.3 ± 3.6	90.0 ± 8.2	73.6 ± 8.5	72.6 ± 6.0	77.0 ± 4.3	75.8 ± 5.2	52.5 ± 11.6	54.0 ± 8.8	5.4 ± 0.9
	Mean-2SD	86.2	73.7	56.7	60.7	69.3	65.4	29.3	36.5	3.7
	Bellis	**85**	**78**	**78**	**78**	**78**	**78**	**72**	**72**	**5.5**
11 (n=10)	Mean ± SD	94.3 ± 6.1	92.0 ± 5.1	80.0 ± 4.6	81.2 ± 5.7	82.4 ± 5.7	82.8 ± 4.6	57.0 ± 9.5	55.0 ± 8.2	5.8 ± 1.7
	Mean-2SD	82.0	82,0	81.8	70.8	69.9	71.0	38.0	38.0	2.4
	Bellis	**90**	**88**	**78**	**78**	**78**	**78**	**75**	**75**	**5.5**
12 (n=10)	Mean ± SD	93.5 ± 4.6	92.8 ± 5.1	82.4 ± 10.7	79.6 ± 11.4	84.8 ± 9.2	82.4 ± 8.3	69.0 ± 7.8	67.9 ± 7.1	6.2 ± 1.2
	Mean-2SD	84.3	82.6	61.0	56.8	66.4	65.9	53.5	53.8	3.7
	Bellis	**90**	**90**	**80**	**80**	**80**	**80**	**78**	**78**	**5.5**

R - Right
L - Left

(Campbell & Wilson, 2003).

Appendix E


G*Power 3.1.9.4
File Edit View Tests Calculator Help
Central and noncentral distributions
Protocol of power analyses
critical t = 1.97143
0.3
0.2
0.1
0
−2
0
2
4
6
β
α/2
Test family
t tests
Statistical test
Means: Wilcoxon-Mann-Whitney test (two groups)
Type of power analysis
A priori: Compute required sample size – given α, power, and effect size
Input Parameters
Tail(s) Two
Parent distribution Normal
Determine =>
Effect size d 0.5
α err prob 0.05
Power (1−β err prob) 0.95
Allocation ratio N2 / N1 1
Output Parameters
Noncentrality parameter δ 3.6235732
Critical t 1.9714300
Df 208.0845
Sample size group 1 110
Sample size group 2 110
Total sample size 220
Actual power 0.9502040
Options
X-Y plot for a range of values
Calculate

Appendix F

Western Cape Government
Education

Directorate: Research

Audrey.wyngaard@westerncape.gov.za
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Fax: 0865902282
Private Bag x9114, Cape Town, 8000
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REFERENCE: 20210112-488
ENQUIRIES: Dr A T Wyngaard

Miss Nomhle Mbele
PO Box 1279
Randpark Ridge
2156

Dear Miss Nomhle Mbele

RESEARCH PROPOSAL: NORMATIVE DATE FOR FREQUENCY PATTERNS TEST IN ASSESSMENT OF CENTRAL AUDITORY PROCESSING DISORDERS OF SOUTH AFRICAN CHILDREN AGED 8 TO 12 YEARS

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **01 February 2021 till 30 June 2021.**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 13 January 2021

Appendix G

FACULTY OF HEALTH SCIENCES

Department of Health & Rehabilitation Sciences

Division of Communication Sciences & Disorders

F46 Old Main Building. Groote Schuur Hospital, Observatory, 7925

Telephone: 021 406-6402

Fax: 021 406-6323

Normative data for Frequency patterns test (assessment of CAPD) for South African children aged 8 to 11 years

Consent form

I ……. (parent/legal guardian) give permission for my child

…….. to participate in the study. I have read and understood the information form about what the study involves. I understand that the identity of the child will remain confidential and will not be published in the final research. I understand that I may withdraw my child from the study at any time with no reason required.

☐ I would like to receive the results from the study.

…….	……	…….
Parent/Legal guardian signature	Contact details	Date

……. ……

Researcher's signature Date

Nomhle Mbele

Mblnom013@myuct.ac.za

+27 84 639 7857

Appendix H

FACULTY OF HEALTH SCIENCES

Department of Health & Rehabilitation Sciences

Division of Communication Sciences & Disorders

F46 Old Main Building. Groote Schuur Hospital, Observatory, 7925

Telephone: 021 406-6402

Fax: 021 406-6323

Normative data for Frequency patterns test (assessment of CAPD) for South African children aged 8 to 11 years

Information letter

You are invited to participate in a study to develop data for South African children for the frequency patterns test. Please read the information below about the study before deciding to participate in this study. For further questions or queries please find my contact details below, a meeting may be set up at the school to meet with the researcher to address any concerns.

Who am I?

My name is Nomhle Mbele. I am a student at the University of Cape Town and I am currently doing my Master's degree in Audiology.

The purpose of this study and how the study will be conducted

The aim of this study is to develop South African data for children that may be used as a standard for the frequency patterns test in assessing how sound is processed in the brain. A frequency patterns test uses sounds played to the child through headphone, where the child has to 1) label the sounds as high pitched or low pitched 2) hum the sounds they hear. The study further aims to compare using statistics the new South African data for children and American data for children for the frequency patterns test. Currently there is no South African based data that can be used when testing children using the Frequency patterns test. Therefore, your child has been invited to participate in this study by going through a few tests to help create new South African data. The study will be conducted through a series of tests that have little risk to your child physically and mentally. The results from the frequency patterns test will be used as data for my Masters research project.

Participating in this study

Deciding to participate in this study is voluntary. Participation will consist of a series of tests that will involve one session between 45- 60 minutes to complete. The session will take place in the afternoons after school or during the school holidays. An appointment will be made by the researcher for this testing session at the Old Main Building at Groote Schuur Hospital. During this session your child will have certain tests and procedures done:

- Recording of your child's personal details such as name, age, gender etc.
- Questionnaire- we will ask a few questions about your child's medical and developmental history.
- Ear examination- the inside of the ear will be looked at by shining a light into the ear to see the canal and ear drum while your child is sitting.
- Middle ear and nerve examination- pressure and sounds are played into the ear and the machine records the responses
- Audiometry- it's a hearing test where sounds are played into the ear through headphones and your child will respond to what they hear.
- Frequency patterns test- sounds will be played into the ear and your child will be asked to describe what s/he hears.

Parents/legal guardians are required to be present for the duration of the session, you may need to take some time off work which won't be reimbursed. None of the assessments are harmful, physically, psychologically and there are no side effects or after effects from any of the tests. Benefits of participation is receiving a free hearing test for your child. Reimbursement of your parking costs will be covered and R50 for traveling costs will be given to you.

Consent form

Parents/legal guardians will be required to sign a consent form to confirm that participation is voluntary and well informed. Once the tests and research has been explained to your child on

the day of testing, they will also be required to sign on the form that they agree to participate. The consent form should be brought with on the day of the testing, no tests will be done without the form. You may withdraw your child from the study at any point during the research before the final submission. No reason is required for the withdrawal from the study.

Will I be anonymous?

Yes. Your child will have an individual session with no other participants present, however you as the parent/ legal guardian are required to be present throughout the session. All information obtained from the testing will be used anonymously, no personal details will be published in the research findings. All test results will be kept confidential, only the research assistant, the researcher and their supervisor will have access to the results.

After the testing

After all the tests have been completed the results will be discussed with you. A copy of all the results from the different tests will be given to you. If there are any results outside of the standard range found during testing, your child will be referred to the UCT diagnostics clinic or the UCT 4th year CAPD assessment and management clinic. Should you want the results of the final research, you can indicate this on the consent form and a copy of the final result will be emailed or send via hard copy to you. Please feel free to contact me via phone or email should you have any questions or queries about the study.

The UCT's Faculty of Health Sciences Human Research Ethics Committee can be contacted on 021 406 6338 in case you have any ethical concerns or questions about your rights or welfare as a participant on this research study.

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Appendix I

FACULTY OF HEALTH SCIENCES

Department of Health & Rehabilitation Sciences

Division of Communication Sciences & Disorders

F46 Old Main Building. Groote Schuur Hospital, Observatory, 7925

Telephone: 021 406-6402

Fax: 021 406-6323

Normatiewe data vir die toets van frekwensiepatrone (assessering van CAPD) vir Suid-Afrikaanse kinders van 8 tot 11 jaar oud

Vrywaringsvorm

Ek…… (ouer/ wettige voog) gee toestemming vir my kind …… .. om aan die studie deel te neem. Ek het die inligtingsvorm oor wat die studie betrek inhougelees en verstaan. Ek verstaan dat die identiteit van my kind vertroulik sal bly en nie in die finale navorsing gepubliseer sal word nie. Ek verstaan dat ek my kind enige tyd aan die studie mag onttrek - sonder dat redegewing enige verklaring nodig is.

☐ Ek wil graag die resultate van die studie ontvang.

……	……	……
Handtekening van ouer/ wettige voog	Kontakbesonderhede	Datum
…….	……	
Navorser se handtekening	Datum	

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Appendix J

I-FACULTY YEHEALTH SCIENCES

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ISahlulo seNzululwazi yoNxibelwano noPhazamiseko

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Uvavanyo lwenkcazo-lwazi ye-*frequency* (uvavanyo lwe-CAPD) olwenzelwe abantwana abaminyaka iyi-8 ukuya kweyi-11

Ifomu yesivumelwano esisemthethweni sokuthabatha inxaxheba

Mna …… (umzali/ umgcini ngokusemthethweni) ndinika imvume ukuba umntwana wam u…….. athabathe inxaxheba kolu hlolisiso. Ndiyifundile ileta yenkcazelo ngolu hlolisiso ndaza ndayiqonda inkcazelo ekuyo ephathelele oko kuza kubandakanyeka kolu hlolisiso. Ndiyaqonda ukuba inkcazelo enento yokwenza nokuba ungubani umntwana wam iza kugcinwa ikhuselekile yaye ayizikupapashwa kwiziphumo zophando. Yaye, ndiyaqonda ukuba ndingamkhupha umntwana wam kolu phando nanini na ndifuna yaye akuzubakho mfuneko yokuba ndixele isizathu soko.

☐ Ndingathanda ukufumana iziphumo zophando.

…….	……	…….
Utyobelo lomzali/ umgcini	Inkcukacha zoqhagamishelwano	Umhla ngokusemthethweni

……. ……

Utyobelo lomphandi Umhla

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Appendix K

FACULTY OF HEALTH SCIENCES

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Normatiewe data vir die toets van frekwensiepatrone (assessering van CAPD) vir Suid-Afrikaanse kinders tussen 8 en 11 jaar

Inligtingsbrief

U word uitgenooi om deel te neem aan 'n studie betrokke by die ontwikkeling van data vir frekwensiepatroontoetse vir Suid-Afrikaanse kinders. Lees asseblief die onderstaande inligting verbonde aan die studie voordat u ’n besluit aangaande u deelname maak. Indien u enige vra of verdere navrae sou hê, vind asseblief my kontakbesonderhede hieronder. ’n vergadering (by die verwante skool) met die navorser kan opgestel word om enige bekommernisse of probleme te bespreek.

Wie is ek?

My naam is Nomhle Mbele. Ek is 'n student aan die Universiteit van Kaapstad en doen tans my meestersgraad in Oudiologie.

Die doel van hierdie studie en hoe die studie uitgevoer sal word

Die doel van hierdie studie is om data by Suid-Afrikaanse kinders te versamel wat kan bydrae tot die standaardisering van frekwensiepatroontoetse – ’n assesering verbonde aan

klankprosessering in die brein. ’n Verdere doel sluit die vergelyking van die statistieke verbonde aan Suid-Afrikaanse en Amerikaanse data vir kinders se frekwensiepatroontoetse in. Daar is tans geen Suid-Afrikaanse gegewens/ data wat gebruik kan word wanneer kinders via die frekwensiepatroontoets geassesseer word nie. Dus word u kind uitgenooi om aan hierdie studie deel te neem en deur hul deelname by te drae tot die skepping van Suid-Afrikaanse gegewens/ data. Die studie sal uitgevoer word deur ’n reeks toetse wat min fisiese en psigiese risiko’s inhou. Die resultate van die frekwensiepatroontoetse sal as data vir my meestersnavorsingsprojek gebruik word.

Deelname aan hierdie studie

Deelname aan hierdie studie berus op ’n vrywillige keuse. Deelname behels ’n reeks toetse wat gedurende een sessie van 45-60 minute uitgevoer sal word. Die sessie sal gedurende die middag na skool of tydens die skoolvakansie plaasvind. Die navorser sal ’n afspraak vir die toetssessie by Groote Schuur-hospitaal se Ou Hoofgebou (Old Main Building) opstel. Tydens hierdie sessie sal u kind sekere toetse en prosedures voltooi:

- Die opneem van u kind se persoonlike besonderhede soos naam, ouderdom, geslag, ens.
- Die invul van ’n vraelys – ’n paar vrae aangaande hul mediese en ontwikkelingsgeskiedenis.
- ’n Oorondersoek – terwyl u kind sit, word die binnekant van die oor word belig om die oorkanaal en oordrom te besigtig.
- Middeloor- en senuwee-ondersoek – die oor word aan drukking en geluide/ klanke blootgestel en die reaksies word deur ’n masjien opgeteken.
- Oudiometrie – dit is 'n gehoortoets waar klanke deur oorfone in die oor gespeel word en u kind se reaksies opgeteken word.
- Frekwensiepatroontoets – geluide/ klanke word in die oor gespeel en u kind sal gevra word om beskrywings van wat hul hoor te bied.

Daar word van ouers/ voogde verwag om vir die duur van die sessie teenwoordig te wees; gevolglik kan dit van ouers/ voogde vereis om tyd van hul werk af te neem – waarvoor terugbetaling nie ontvang sal word nie. Geen van die assesserings is fisies of psigies skadelik nie en daar is geen newe-effekte of na-effekte nie. Die voordele verbonde aan deelname sluit die ontvang van ’n gratis gehoortoets vir u kind in. Die terugbetaling van u parkeerkoste word gedek en R50 vir reiskoste sal aan u toegestaan word.

Toestemmingsvorm

Ouers / voogde moet 'n toestemmingsvorm onderteken om te bevestig dat deelname vrywillig is en dat hul goed ingelig is. Nadat die toetse en navorsing – op die toetsdag – aan u kind

verduidelik is, sal hulle ook moet onderteken dat hulle instem om deel te neem. Die toestemmingsvorm moet op die toetsdag saamgebring word; geen toetse sal sonder die vorm uitgevoer word nie. U kan u kind enige tyd – tydens die navorsing tot en met die finale indiening van die navorsing – vanuit die studie onttrek. Geen verklaring vir die onttrekking word vereis nie.

Sal ek anoniem wees?

Ja. U kind sal aan ’n enkele sessie – sonder die teenwoordigheid van ander deelnemers – deelneem; u, as ouer/ voog, moet egter gedurende die hele sessie teenwoordig bly. Alle inligting wat vanuit die toetsing verkry word, sal as anoniem hanteer word; geen persoonlike besonderhede sal in die navorsingsresultate gepubliseer word nie. Alle toetsuitslae sal vertroulik gehou word – slegs die navorsingsassistent, die navorser en hul studieleier sal toegang tot die resultate hê.

Hoe word die inligting, verkry vanuit die toetse, gebruik?

U kind se besonderhede sal van enige resultate verwyder word. Die toetsuitslae wat vanuit u kind se frekwensiepatroontoets verkry word, sal geanaliseer word en as deel van ’n enkele stel resultate vorm. Hierdie stel resultate sal gebruik word om die data te vorm wat in die finale navorsingsbevindinge geplaas kan word en hopelik later as deel van die gestandaardiseerde data gebruik kan word wanneer kinders in Suid-Afrika frekwensiepatroontoetse ondergaan.

Na die toetsing

Nadat al die toetse voltooi is, sal die resultate met u bespreek word. ’n Afskrif van die resultate van die verskillende toetse sal aan u gegee word. Indien enige van die resultate wat tydens die toetsing geregistreer word buite die standaardreeks val, sal u kind na UK (UCT) se diagnostiese kliniek of die 4de-jaars se CAPD-assessering-en bestuurskliniek verwys word. As u die resultate van die finale navorsing sou wou bekom, kan u dit op die toestemmingsvorm aandui – ’n afskrif van die finale uitslae sal per e-pos of as harde kopie aan u gestuur word. Kontak my gerus telefonies of per e-pos indien u enige vrae of navrae oor die studie sou hê. UK (UCT) se Fakulteit Gesondheidswetenskappe se Human Research Ethics Committee (Menslike Navorsingsetiekkomitee) kan via 021 406 6338 gekontak word – in geval u enige etiese bekommernisse of vrae het oor u regte of welsyn as deelnemer aan hierdie navorsingstudie.

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Appendix L

I-FACULTY YEHEALTH SCIENCES

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Uvavanyo lwenkcazo-lwazi ye-frequency (uvavanyo lwe-CAPD) olwenzelwe abantwana abaminyaka iyi-8 ukuya kweyi-12.

Ileta yenkcazelo

Uyamenywa ukuba uthabathe inxaxheba kuphando lokuphuhlisa inkcazo-lwazi yovavanyo lweephatheni ze-*frequency.* Nceda ufunde inkcazelo elandelayo engolu hlolisiso ngaphambi kokuba ugqibe kwelokuba uthabathe inxaxheba. Xa unemibuzo nezikhalazo, nceda ufumane iinkcukacha zokuqhagamishelana nam ekupheleni kwale leta. Njengomphandi kolu hlolusiso, ndikulungele ukudibana nawe kwintlanganiso enokuba sesikolweni somntwana wakho ukuphendula imibuzo nezikhalazo osenokuba unazo.

Ndingubani?

Igama lam nguNomhle Mbele, ndenza izifundo zesidanga seeMasters zeAudiology kwiDyunivesithi yaseKapa (UCT).

Injongo nendlela oluza kuqhutywa ngayo olu hlolisiso

Injongo yolu hlolisiso kukuphuhlisa inkcazo-lwazi eMzantsi Afrika enokusetyenziswa njengomgangatho-myinge kuvavanyo lweephatheni ze-*frequency* lokuvavanya indlela isandi esiqondwa ngayo ziigqondo zabantwana. Uvavanyo lweephatheni ze-frequency lusebenzisa izandi ezidlalwa ezindlebeni zabantwana zidlalwa ngezixhobo zesandi ezifakwa ezindlebeni (iiheadphones) apho umntwana 1) axelayo ukuba isandi sitswinela ezantsi okanye sitswinela phezulu na, 2) ahum-humze isandi eso asivayo kwizixhobo zendlebe. Ngokubhekele phaya, olu hlolisiso lujonge ukuthelekisa, ngokwamanani ayinkcazelo (istatistiki), inkcazo-lwazi entsha yovavanyo lweephatheni ze-frequency yolu hlolisiso kunye naleyo yabantwana baseMelika. Kungoku nje, akukukho nkcazo-lwazi esekelwe kwiziphumo zohlolisiso olwenziwe kubantwana beli enokusetyenziswa xa kusenziwa uvavanyo lweephatheni ze-*frequency*. Ngoko ke, umntwana wakho uyamenywa ukuba athabathe inxaxheba kolu hlolisiso ngokuba enziwe uvavanyo olumbalwa ukunceda ukuqulunqa inkcazo-lwazi entsha yoMzantsi Afrika. Olu hlolisiso luza kwenziwa ngokuba umntwana wakho avavanywe ngeemvamvanyo ezimbalwa ezingambeki bungciphekweni emzimbeni nakubume bengqondo yakhe. Iziphumo ezisuka kukuvavanyo lweephatheni ze-*frequency* zizakusetyenziselwa ukuba yinkcazo-lwazi kwiprojeckthi yolu phando lwam lwesidanga see-Masters.

Ukuthabatha inxaxheba kolu hlolisiso

Ukuthabatha inxaxheba koluhlolisiso kungokokuzithandela. Ukuthabatha inxaxheba kuza kuquka ukuvavanywa kambalwa kwiiseshoni ezithatha imizuzu ephakathi kweyi-45 neyi-60. Ezi seshoni ziza kuba semva kwemini xa kuphume isikolo okanye ngethuba leeholide zesikolo. Ixesha leseshoni yovavanyo nganye liza kulungiselelwa ngumphandi eOld Main Building kwisiBhedlele iGroote Schuur. Kwiseshoni yophando, umntwana uza kuvavanywa ngolu hlobo lulandelayo:

- Ukushicilelwa kweenkcukacha zobuqu zomntwana ezifana negama, ubudala, isini njalo-njalo.
- Ifomu yemibuzo- siza kubuza imibuzo embalwa ngembali yemo yempilo yomntwana neyokukhula okanye ukuphuhla kwakhe.
- Uhlolisiso lweendlebe- umphakathi wendlebe uza kuhlolwa ngokukhanyisa ilitha endlebeni ukubona umphakathi wendlebe logama umntwana eza kuba ehleli esitulweni.
- Uhlolisiso lombindi wendlebe nemithambo-luvo- indlebe iza kuzaliswa ngomoya kudlalwe nesandi logama umatshini owenzelwe ukumeta iziphumo zoko uza kwenjenjalo.
- I-Audiometry- luvavanyo lokuva apho izandi zidlalelwa indlebe kusetyenziswa isixhobo seendlebe (headhones) yaye umntwana uza kuxela oko akuvayo.
- Uvavanywa lweephatheni ze-*frequency*- izandi ziza kudlalwa endlebeni yomntwana ze yena achaze oko akuvayo.

Abazali/ abangcini abasemthethweni, kuyimfuneko ukuba babekhona kwiseshoni nganye yovavanyo. Loo nto ithetha ukuba kusenokuba ungayi emsebenzini. Awuzukufumana mbuyekezo ngoko. Akukho nalunye uvavanyo oluyingozi emzimbeni, egqondweni yaye akukho nalunye

olunemiphumo emibi. Iingenelo zokuthabatha inxaxheba kolu phando kukufumana uvavanyo lokuva lwasimahla komntwana wakho. Imbuyekezo eyi-R10 yeendleko zokupaka uza kuyinikwa yaye i-R50 yeendleko zendlela.

Ifomu yesivumelwano esisemthethweni sokuthabatha inxaxheba

Abazali/ abagcini ngokusemthethweni kuza kufuneka batyobele ifomu yesivumelwano esisemthethweni sokuthabatha inxaxheba ukungqina ukuba inxaxheba yabo ingokuzithandela yaye bayayiqonda eyona njongo nendlela olu phando luza kenziwa ngayo. Lwakuba uvavanyo nophando lucacisiwe emntwaneni wakho ngomhla wovavanyo, kuza kufuneka naye atyobele le fomu ukuba uyavuma ukuthabatha inxaxheba. Kuza kufuneka uyiphathe ifomu ngomhla wovavanye, kungenjalo akukhovavanyo luza kenziwa ngaphandle kwayo. Ungamkhupha umntwana wakho kolu phando nanini na ngaphambi kokufakwa kwale projekthi. Akukhomfuneko yokuba uxele isizathu sokumkhupha umntwana wakho kolu phando.

Ingaba liza kwaziwa igama lomntwana wakho?

Hayi. Umntwana uza kuba kwiseshoni yakhe yedwa apho kuza kube kungekho abanye abathabathi-nxaxheba. Kodwa ke, wena njengomzali/mgcini ngokusemthethweni, kuyimfuneko ukuba ubekhona ngalo lonke ixesha lovavavanyo. Yonke inkcazelo efunyenweyo kolu vavanyo ayizikubhalwa gama lomntwana yaye iinkcukacha zobuqu zomntwana azizikupapashwa neziphumo zophando. Zonke iziphumo zovavanyo zizakugcinwa ziyimfihlo. Kuphela, umncedisi koluphando, umphandi kunye nomxhasi kolu phando, ngabo abaza kuzibona iziphumo.

Emva kovavanyo

Emva kokuba kugqitywe lonke uvavanyo, iziphumo ziza kuxoxwa kunye nawe. Ikopi yeziphumo zalo lonke uvavanyo uza kuyinikwa. Ukuba kukho naziphi na iziphumo ezingaphaya kwemida yomlinganiselo oqhelekileyo, umntwana wakho uza kuthunyelwa kwiKlini ye-diagnostics yase-UCT okanye i-*UCT 4TH year CAPD assessment and management clinic.* Ukuba unomdla wokufumana iziphumo zolu phando lulonke, ungakuphawula oko kwifomu yesivumelwano esisemthethweni sokuthabatha inxaxheba yaye ikopi yeziphumo iza kuthunyelwa nge-email okanye iposwe. Nceda ukhululeke ukuqhagamishelana nam nge-phone okanye i-email xa kusenzeka ube nemibuzo okanye izikhalazo ngolu phando.

IKomiti yeMilinganiselo yoPhando olungaBantu yeFakhalthi yeNzululwazi ngezeMpilo kwiDyunivesithi yaseKapa kungaqhaganishelwana nayo kule nombolo: 021 406 6338 xa kunokwenzeka kubekho nto zimbi zinokuthanani nemilinganiselo yophando ezikuxhalabisayo, okanye imibuzo ngokuphathelele amalungelo okanye impilo-ntle yakho njengomthabathi-nxaxheba kolu phando.

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Appendix M

Adaptation of Process of creating normative data Framework

Original Framework	Adapted Framework
• **Sample**- recruiting participants	• **Planning**- development of resources and preparation of equipment
• **Instruments** – explanation of different screening tools used in the study.	• **Recruitment** - using information letters at the identified schools
• **Clinical and demographics interview** - determine inclusion or exclusion in the study using criteria.	• **Screening** -with Case History, Otoscopic examination, Tympanometry, Acoustic reflexes, Pure Tone Audiometry.
• **Screening tests-** screening for inclusion and exclusion criteria	
• **Neuropsychological tests** - assessments administered for the data collection.	• **Assessment** –Frequency patterns test for data collection
• **Procedure** –process throughout the data collection.	
• **Statistical analysis** -accuracy of the final sample, the reliability and the normative data collected	• **Statistical analysis** -by collating data, creating normative data set and comparing existing norms with the new data set.

Appendix N

Frequency patterns test instructions

Verbal responses

- "For this test you are going to hear 3 different sounds in your left/right ear and after you hear all 3 sounds you must tell me what you heard. For example, you will hear (vocalize biip-beep-biip) and you must say high-low-high or (vocalize beep-beep-biip) and you must say low-low-high."
- "So we are going to practice a few with the headphones and then when you are ready we will start the test."
- After practice: "That's good, let's start now."

Hummed responses

- "For this test you are going to hear 3 different sounds again in your left/right ear and after you hear all 3 sounds this time you must sing what you heard. For example, you will hear (vocalize biip-beep-biip) and you must sing high-low-high or (vocalize beep-beep-biip) and you must sing low-low-high."
- "So we are going to practice a few again with the headphones and then when you are ready we will start the test."
- After practice: "That's good, let's start now."

Appendix O

Verbale/ woordelikse reaksies:

- “Vir die volgende toets/ Tydens hierdie toets gaan u drie (3) verskillende geluide/ klanke in u linker-/ regteroor hoor. Nadat u al drie die geluide gehoor het, moet u my vertel/ terugrapporteer (report back) wat u gehoor het. U sal byvoorbeeld (spreek ‘biip-biep-biip’ uit/ vokaliseer ‘biip-beep-biip’) hoor en u moet sê/ aandui ‘hoog-laag-hoog’ of u sal byvoorbeeld (vokaliseer: ‘beep-beep-biip’) hoor en dan moet u sê/ aandui dat dit laag-laag-hoog is”.
- “Ons gaan ‘n paar oefenlopies/ oefenrondtes met die oorfone uitvoer/ doen en dan sal ons, wanneer u gereed is, met die toets begin.”
- Na die oefening: “Dit is goed, laat ons nou begin/ kom ons begin.”

Neurie reaksies:

- “Vir hierdie toets gaan u weer drie (3) verskillende geluide in u linker-/ regteroor hoor. Nadat u al drie die geluide gehoor het, moet u dit wat u gehoor het, sing/ neurie. U sal byvoorbeeld (vokaliseer: biip-beep-biip) hoor en u moet dan hoog-laag-hoog neurie/ sing/ sê of u sal byvoorbeeld (vokaliseer: ‘beep-beep-biip’) hoor en dan moet u laag-laag-hoog neurie/ sing/ sê”.
- “Ons gaan ‘n paar oefenlopies/ oefenrondtes met die oorfone uitvoer/ doen en dan sal ons, wanneer u gereed is, met die toets begin.”
- Na die oefening: “Dit is goed, laat ons nou begin/ kom ons begin.”

Appendix P

Imiyalelo yovavanyo lweephatheni ze-frequency

Iimpendulo ezithethwayo

- "Kolu vavanyo uzakuva izandi eziyi-3 ezingafaniyo kwindlebe yakho yasenxele okanye kweyasekunene. Xa uzive zoyi-3 ezi zandi, nceda undazise ukuba uve ntoni. Ngokomzekelo, uzakuva u-biip-beep-biip, kuza kufuneka ke wena uthi phezulu-ezantsi-phezulu okanye, uzakuva u-beep-beep-biip uze wena uthi ezantsi-ezantsi-phezulu."
- "Ngoku siza kuqhelisela nje kube kambalwa ngezi-headphones. Xa sele ukulungele ukuqalisa, siza kuluqalisa uvavanyo."
- Emva koqheliselo: "Wenze kakuhle, masiqalise."

Iimpendulo ezenziwe ngesandi somlomo

- "Nakolu uvavanyo uza kuva izandi eziyi-3 ezingafaniyo kwindlebe yakho yasenxele okanye kweyasekunene. Emva kokuva zonke ezi zandi zintathu, umele ucule oko ukuvileyo. Ngokomzekelo, uzakuva u-biip-beep-biip. Emva kokuva ezi zandi umele wena ucule phezulu-ezantsi-phezulu; okanye uzakuva u-beep-beep-biip yaye wena umele ucule ezantsi-ezantsi-phezulu."
- "Ngoku siza kuqhelisela nje kube kambalwa ngezi-headphones. Xa sele ukulungele ukuqalisa, siza kuluqalisa uvavanyo."
- Emva koqheliselo: "Wenze kakuhle, masiqalise."

Appendix Q

FACULTY OF HEALTH SCIENCES

Department of Health & Rehabilitation Sciences

Division of Communication Sciences & Disorders

F46 Old Main Building. Groote Schuur Hospital, Observatory, 7925

Telephone: 021 406-6402

Fax: 021 406-6323

Normative data for Frequency patterns test (assessment of CAPD) for South African children aged 8 to 11 years

Assent form

I……..agree to be part of this study. The tests I will be part of have been explained to me.

…… ……

Participant/child's Signature Date

…… ……

Researcher's signature Date

Nomhle Mbele

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Appendix R

FACULTY OF HEALTH SCIENCES

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Division of Communication Sciences & Disorders

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Telephone: 021 406-6402

Fax: 021 406-6323

Normatiewe data vir die toets van frekwensiepatrone (assessering van CAPD) vir Suid-Afrikaanse kinders van 8 tot 11 jaar oud.

Ons doen 'n studie oor 'n spesiale gehoortoets. ’n Studie is 'n manier om meer oor mense te leer. As u besluit om aan die studie deel te neem, sal u die gehoortoetse in 'n baie stil kamer doen. Ons sal die stappe van die toets aan u verduidelik en u kan vrae vra of ons enige tyd vra om te stop.

Instemmingvorm

Ek …… stem in om aan hierdie studie deel te neem. Die toetse waaraan ek gaan deelneem, was aan my verduidelik.

…… ……..

Deelnemer/ kind se handtekenings Datum

…….. ……

Navorser se handtekening Datum

Nomhle Mbele

Mblnom013@myuct.ac.za

+27 84 639 7857

Appendix S

I-FACULTY YEHEALTH SCIENCES

ISebe lezeMpilo neNzululwazi yoHlaziyo

ISahlulo seNzululwazi yoNxibelelwano noPhazamiseko

F46 Old Main Building. Groote Schuur Hospital, Observatory, 7925

Telephone: 021 406-6402

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Uvavanyo lwenkcazo-lwazi ye-*frequency* (uvavanyo lwe-CAPD) olwenzelwe abantwana abaminyaka iyi-8 ukuya kweyi-11.

Senza uhlolisiso ngovavanyo olukhethekileyo oluvavanya ukuva kweendlebe. Uhlolisiso yidlela yokufunda okungakumbi ngabantu. Ukuba ugqiba kwelokuba ufuna ukuba yinxaxheba yolu hlolisiso ngokuvavanywa ukuva kweendleba zakho, uza kuvavanywa ukuva kwigumbi elingenangxolo. Siza kukucacisela ukuba olu vavanyo luhamba njani ngokwezigaba zalo yaye uvumelekile ukubuza imibuzo nokuyeka ukuthabatha inxaxheba kulo nanini na ufuna.

Ifomu yokuvuma ukuthabatha inxaxheba

Mna……..ndiyavuma ukuthabatha inxaxheba kolu hlolisiso. Uvavanyo endiza kuba yinxalenye yalo ndilucaciselwe ukuba luza kuhamba njani.

……. …….

Utyobelo lomthabathi-nxaxheba/lomntwana Umhla

……. ……

Utyobelo lomphandi Umhla

Nomhle Mbele

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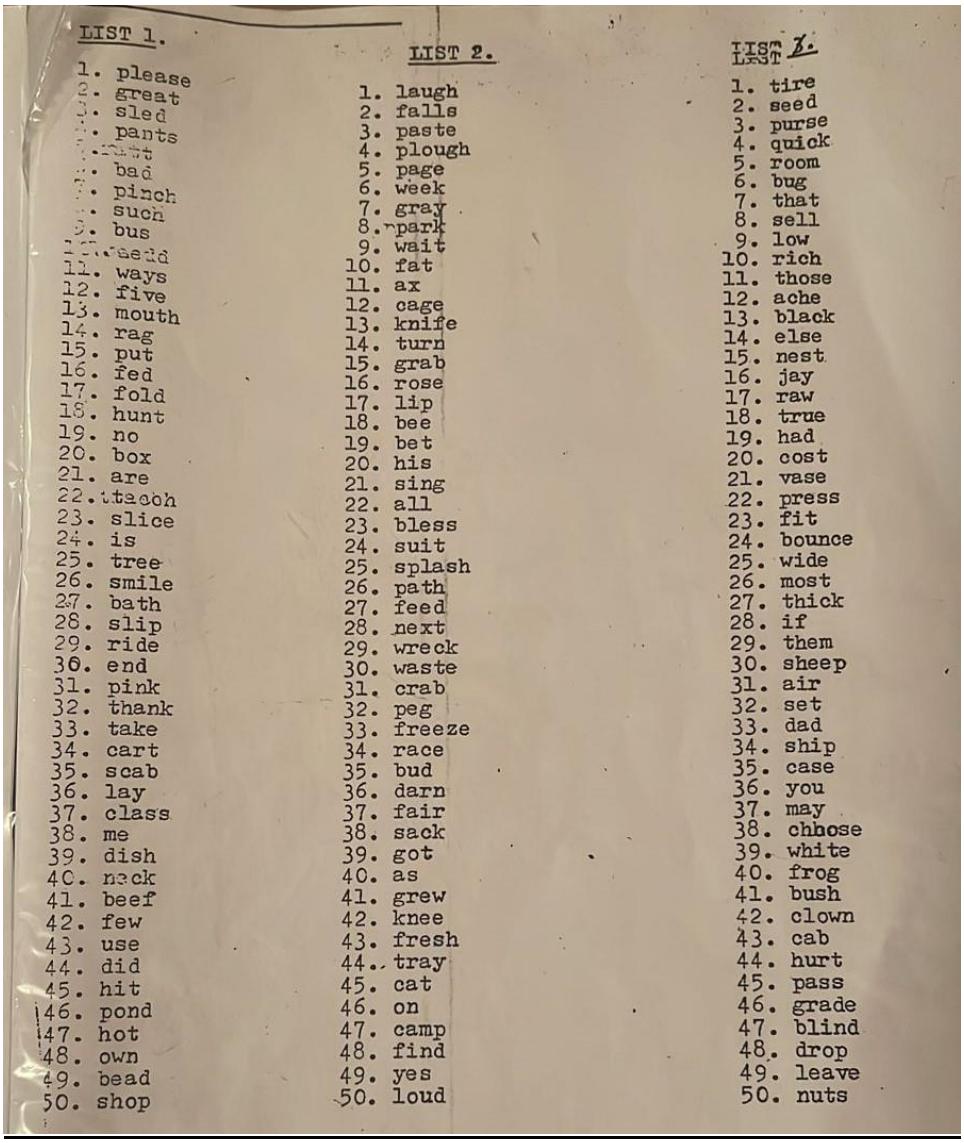
Appendix T

Case History Questions

- What is your child's home language or preferred language?
- Does he/she have a history of hearing loss?
- Does he/she have a history of ear infections?
- Does he/she have a history of head or neck injuries?
- Does he/she have a history of head or neck surgeries?
- Does he/she struggle with anything at school? Including academics and social aspects.
- Has he/she been diagnosed with any developmental or learning difficulties?
- Has he/she been diagnosed with any cognitive or mental difficulties?
- Has he/she been diagnosed with any neurological conditions (conditions that affect the brain, spine or nerves)?
- Has he/she been diagnosed with any speech and language difficulties?
- Has he/she received any Speech therapy? If so, for what?
- Has he/she received any Occupational therapy? If so, for what?
- Do you as a parent/legal guardian of the child have any concerns with their hearing?

Appendix U

English Monosyllabic Word list



LIST 1.

1. please
2. great
3. sled
4. pants
5. bad
6. pinch
7. such
8. bus
9. seed
10. ways
11. five
12. mouth
13. rag
14. put
15. fed
16. fold
17. hunt
18. no
19. box
20. are
21. teach
22. slice
23. is
24. tree
25. smile
26. bath
27. slip
28. ride
29. end
30. pink
31. thank
32. take
33. cart
34. scab
35. lay
36. class
37. me
38. dish
39. neck
40. beef
41. few
42. use
43. did
44. hit
45. pond
46. hot
47. own
48. bead
49. shop
50.

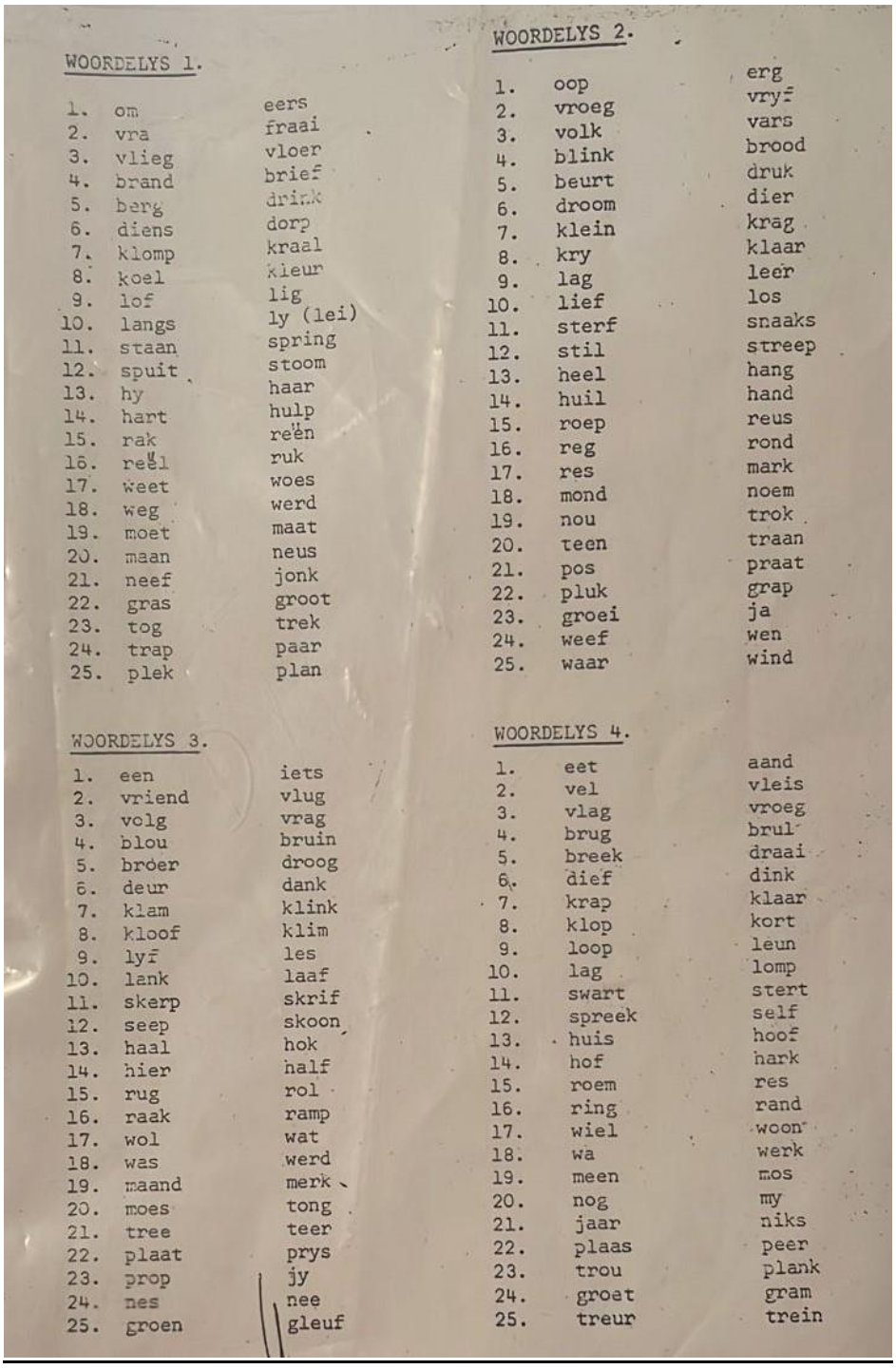
LIST 2.

1. laugh
2. falls
3. paste
4. plough
5. page
6. week
7. gray
8. park
9. wait
10. fat
11. ax
12. cage
13. knife
14. turn
15. grab
16. rose
17. lip
18. bee
19. bet
20. his
21. sing
22. all
23. bless
24. suit
25. splash
26. path
27. feed
28. next
29. wreck
30. waste
31. crab
32. peg
33. freeze
34. race
35. bud
36. darn
37. fair
38. sack
39. got
40. as
41. grew
42. knee
43. fresh
44. tray
45. cat
46. on
47. camp
48. find
49. yes
50. loud

LIST X.

1. tire
2. seed
3. purse
4. quick
5. room
6. bug
7. that
8. sell
9. low
10. rich
11. those
12. ache
13. black
14. else
15. nest
16. jay
17. raw
18. true
19. had
20. cost
21. vase
22. press
23. fit
24. bounce
25. wide
26. most
27. thick
28. if
29. them
30. sheep
31. air
32. set
33. dad
34. ship
35. case
36. you
37. may
38. chhose
39. white
40. frog
41. bush
42. clown
43. cab
44. hurt
45. pass
46. grade
47. blind
48. drop
49. leave
50. nuts

Afrikaans Monosyllabic Word list



WOORDELYS 1.

1.	om	eers
2.	vra	fraai
3.	vlieg	vloer
4.	brand	brief
5.	berg	drink
6.	diens	dorp
7.	klomp	kraal
8.	koel	kleur
9.	lof	lig
10.	langs	ly (lei)
11.	staan	spring
12.	spuit	stoom
13.	hy	haar
14.	hart	hulp
15.	rak	reën
16.	reël	ruk
17.	weet	woes
18.	weg	werd
19.	moet	maat
20.	maan	neus
21.	neef	jonk
22.	gras	groot
23.	tog	trek
24.	trap	paar
25.	plek	plan

WOORDELYS 2.

1.	oop	erg
2.	vroeg	vryf
3.	volk	vars
4.	blink	brood
5.	beurt	druk
6.	droom	dier
7.	klein	krag
8.	kry	klaar
9.	lag	leer
10.	lief	los
11.	sterf	snaaks
12.	stil	streep
13.	heel	hang
14.	huil	hand
15.	roep	reus
16.	reg	rond
17.	res	mark
18.	mond	noem
19.	nou	trok
20.	teen	traan
21.	pos	praat
22.	pluk	grap
23.	groei	ja
24.	weef	wen
25.	waar	wind

WOORDELYS 3.

1.	een	iets
2.	vriend	vlug
3.	volg	vrag
4.	blou	bruin
5.	broer	droog
6.	deur	dank
7.	klam	klink
8.	kloof	klim
9.	lyf	les
10.	lank	laaf
11.	skerp	skrif
12.	seep	skoon
13.	haal	hok
14.	hier	half
15.	rug	rol
16.	raak	ramp
17.	wol	wat
18.	was	werd
19.	maand	merk
20.	moes	tong
21.	tree	teer
22.	plaat	prys
23.	prop	jy
24.	nes	nee
25.	groen	gleuf

WOORDELYS 4.

1.	eet	aand
2.	vel	vleis
3.	vlag	vroeg
4.	brug	brul
5.	breek	draai
6.	dief	dink
7.	krap	klaar
8.	klop	kort
9.	loop	leun
10.	lag	lomp
11.	swart	stert
12.	spreek	self
13.	huis	hoof
14.	hof	hark
15.	roem	res
16.	ring	rand
17.	wiel	woon
18.	wa	werk
19.	meen	mos
20.	nog	my
21.	jaar	niks
22.	plaas	peer
23.	trou	plank
24.	groet	gram
25.	treur	trein

Appendix V

Norms for clinical assessments

❖ Otoscopy

External ear canal clear of malformations, blockage from atresia, stenosis, cerumen, foreign bodies or debris and signs of disease (Diefendorf, 2015).

Tympanic membrane clear of signs of disease and is semi-translucent, pearly-grey and slightly concave (Rappaport & Provencal, 2002).

❖ Immitance

Tympanometry

Norms for Immitance Values (226 Hz)

	Compliance/ Peak Y ECV		Pressure
	(cm3) *range*	(cm3) *range*	(daPa) *range*
Children (3 to 5yrs)	0.2-1.8	0.4-1.0	-100-+50
Adults	0.2-2.0	0.2-2.0	-150-+100

(Katz, 2002).

❖ Acoustic Reflexes (AR)

AR thresholds should be between 70- 90 dB above the pure tone hearing thresholds at the following frequencies: 500Hz, 1000Hz, 2000Hz and 4000Hz. This applies for both ipsilateral and contralateral tests bilaterally (Feeney &Schairer, 2015).

❖ Pure Tone Audiometry

Interpretation of Degree of Hearing Loss:

(dBHL)	Degree
-10 to 15	Normal
16 – 25	Slight
26 – 40	Mild
41 – 55	Moderate
56 – 70	Moderately-Severe
71 – 90	Severe
> 90	Profound

(Katz, 2002)

- **Pure Tone Average**

  The air conduction thresholds average of 500Hz, 1000Hz and 2000Hz in each ear. If there is a sharply sloping or sharply rising audiogram configuration then it's the average between the two lowest thresholds at 500Hz, 1000Hz and 2000Hz. (Kreisman, Smart & John, 2015).

- **Speech Detection Threshold (SDT) test**

  Estimate level in dBHL at which words are repeated back correctly 50% of the time (Gelfand, 2009; McArdle & Hnath-Chisolm, 2015). The SRT result should be within 2dB of the Pure Tone Average from the Pure Tone Audiometry results (Gelfand, 2009).

- **Frequency patterns test**

  A response will be considered correct when the participant labels the sequence with all three tones present and in the order the stimulus is presented.

Appendix W

Recording Sheet

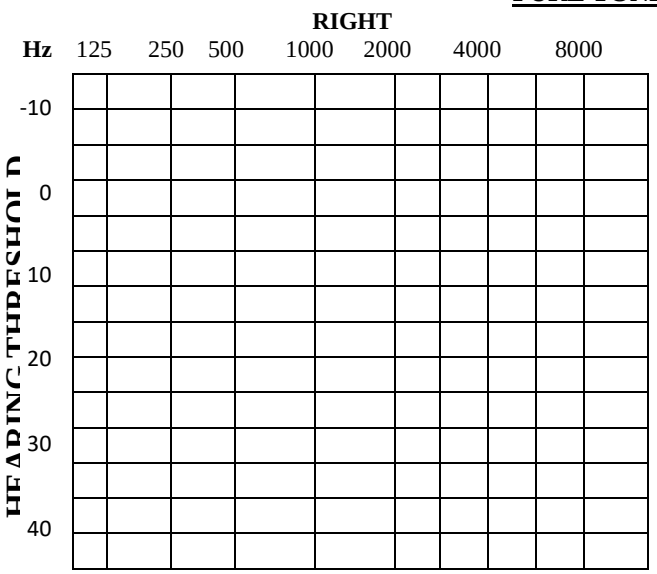
DIVISION OF COMMUNICATION SCIENCES & DISORDERS
GROOTE SCHUUR HOSPITAL
UNIVERSITY OF CAPE TOWN

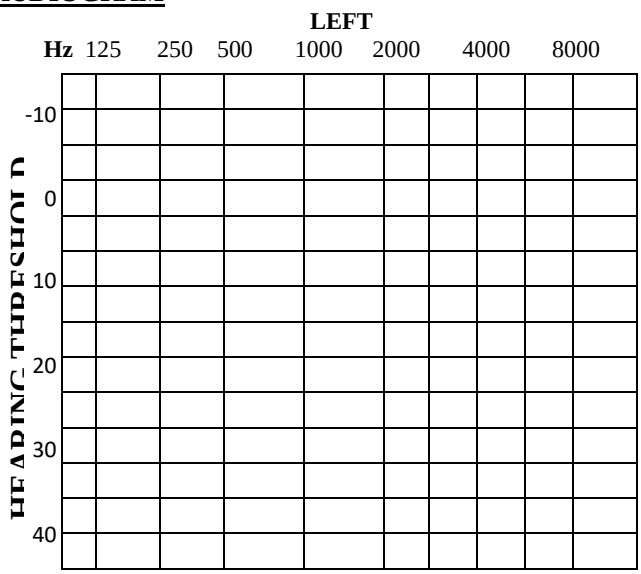
AUDIOLOGICAL ASSESSMENT

Surname & Initials: _____
Folder No.: _____
Date of Birth: _____
Telephone: _____
Test Date: _____
Audiologist: _____
Audiometer: _____
Test Reliability: _____
Pure Tone Average: Right _____dB
Left _____dB

MODALITY	RESPONSE			NON-RESPONSE		
	Left Blue	Unspecified	Right Red	Left Blue	Unspecified	Right Red
Air Conduction A/C Masked	× □		O △	× □		O △
Bone Conduction	>	^	<	>	^	<
B/C Masked	]		[	]		[
AR – Contra AR - Ipsi	- -		- -	↴ ↴		↾ ↾
Free Field	×	S	O	×	S	O
CNE	Could Not Evaluate					

PURE TONE AUDIOGRAM





Masking Levels to Non-Test Ear. Type of Masking _____

Hz	250	500	1k	2k	4k	8k
A/C						
B/C						

Masking Levels to Non-Test Ear. Type of Masking _____

Hz	250	500	1k	2k	4k	8k
A/C						
B/C						

IMMITTANCE MEASURES

STANDARD TYMPANOGRAM

	Type	daPa	ml	ECV
Right				
Left				

ACOUSTIC REFLEX THRESHOLDS

Sound To	CONTRA dB	IPSI Hz	IPSI dB	Sound To	CONTRA dB	CONTRA Hz	CONTRA dB

SPECIAL TESTS

OTOSCOPY RESULTS

RIGHT:

LEFT:

FREQUENCY PATTERNS TEST

RIGHT		**LEFT**	
HUMMED	LABELED	HUMMED	LABELED

CASE HISTORY

CONCLUSIONS AND RECOMMENDATIONS

_____

AUDIOLOGIST

Appendix X

Researcher Agreement Table

		Camilla	Mercedes	Nomhle		Agreement
	Assessment				**Ratio**	
Participant A	Description (R)	46.67%	46.67%	46.67%	**3/3**	**1.00**
	Humming (R)	20%	20%	40%	**2/3**	**0.6**
	Description (L)	46.67%	46.67%	46.67%	**3/3**	**1.00**
	Humming (L)	66.67%	66.67%	73.33%	**2/3**	**0.6**
Participant B	Description (R)	33.33%	33.33%	33.33%	**3/3**	**1.00**
	Humming (R)	80%	86.67%	100%	**0/3**	**0.00**
	Description (L)	46.67%	46.67%	46.67%	**3/3**	**1.00**
	Humming (L)	93.33%	73.33%	93.33%	**2/3**	**0.6**
Participant C	Description (R)	100%	100%	100%	**3/3**	**1.00**
	Humming (R)	100%	100%	100%	**3/3**	**1.00**
	Description (L)	100%	100%	100%	**3/3**	**1.00**
	Humming (L)	100%	80%	100%	**2/3**	**0.6**
Participant D	Description (R)	100%	100%	100%	**3/3**	**1.00**
	Humming (R)	100%	100%	100%	**3/3**	**1.00**
	Description (L)	86.67%	86.67%	86.67%	**3/3**	**1.00**
	Humming (L)	93.33%	100%	100%	**2/3**	**0.6**
Participant E	Description (R)	93.33%	93.33%	100%	**2/3**	**0.6**
	Humming (R)	100%	86.67%	100%	**2/3**	**0.6**
	Description (L)	93.33%	93.33%	93.33%	**3/3**	**1.00**
	Humming (L)	93.33%	86.67%	100%	**0/3**	**0**
Total Agreement:						**0.76**

Appendix Y

FACULTY OF HEALTH SCIENCES

Department of Health & Rehabilitation Sciences

Division of Communication Sciences & Disorders

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Telephone: 021 406-6402

Fax: 021 406-6323

Normative data for Frequency patterns test (assessment of CAPD) for South African children aged 8 to 11 years

Research assistant consent and confidentiality agreement form.

I ……. agree to participate in the study as a research assistant. I have read and understood the information form about what the study involves. I understand:

1. My duties as a research assistant include:
    a. assessing the participant for inclusion in the study
    b. assessing for data collection and recording all test results
    c. Giving feedback on test results
    d. Informational counselling to the participant and parent/legal guardian
    e. making relevant referrals if abnormal results are obtained
2. I may not discuss or share any research information in any form with anyone other than the researcher.
3. All research information in my possession must be kept secure.

4. When my research duties are complete I must return all research information in any form to the researcher. No research information may be retained by me.

For any further questions or queries you may contact the researcher. The UCT's Faculty of Health Sciences Human Research Ethics Committee can be contacted on 021 406 6338 in case you have any ethical concerns or questions about your rights or welfare as a participant in this research study.

…….	……	……..
Research assistant	Assistant's Signature	Date

…….	…….
Researcher's signature	Date

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