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SELECTIVE AUDITORY ATTENTION AND SPEECH-IN-NOISE PERCEPTION IN ENGLISH SECOND LANGUAGE LEARNERS

by

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Supervisors:

Prof. Lidia Pottas and Prof. Maggi Soer

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Declaration of originality

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Abstract

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Title	Selective auditory attention and speech-in-noise perception in English second language learners

Abstract

Background: Selective auditory attention and speech-in-noise perception are key skills required by school-aged children for the development of academic skills that will ensure overall learning success in a school context. These skills are indispensable for English second language (ESL) learners to achieve successful academic learning, as their learning takes place through an additional language. Second language acquisition is influenced by several factors pertaining to auditory processing skills, such as age of onset of acquisition and age of exposure to an additional language. As yet no studies have investigated the selective auditory attention abilities and speech-in-noise perception of young ESL learners in a multilingual country such as South Africa.

Aim: To determine the selective auditory attention abilities and speech-in-noise perception of seven-to-eight-year-old ESL learners in a multilingual country and compare their results to those of English first language (EFL) learners of the same age.

Method: A quantitative, descriptive, comparative cross-sectional research design was used to determine the selective auditory attention abilities and speech-in-noise perception skills of 40 children with normal hearing in first or second grade (aged seven-to-eight-years). The control group comprised 20 EFL learners (mean age 7.35 years ± 0.49) and the research group included 20 second language learners (mean age 7.70 years ± 0.47). The researcher also compared the control and research groups with regard to the age of exposure to English through various sources. The Mann Whitney test was used for this comparison. Information regarding the age of exposure was gathered by means of a case history

questionnaire which was completed by the parents/guardians of the participants. The Selective Auditory Attention Test (SAAT) and Digits-in-Noise (DIN) test were performed in one sitting.

Results: No statistically significant differences between the EFL and ESL groups were found for the SAAT and DIN. However, a statistically significant difference was obtained between the SAAT lists 1 and 3 and the DIN: diotic listening condition for the ESL group only (r_s= -0.623; p=0.003). The difference in the mean age of exposure to English between the EFL and ESL groups was statistically significant (p=0,019), with mean age of exposure to English in the ESL group (mean = 2.82 ± 0.53) being higher than the mean age of exposure in the EFL group (mean = 1.81 ± 1.53). However, the latter did not influence the results of the SAAT and DIN significantly.

Conclusion: The main finding was that selective auditory attention and speech-in-noise perception were not significantly affected in the ESL learners who participated in the study – learners who were recruited from private schools located in an urban area and thus from higher socio-economic status (SES) households. This points to the possibility of additional or alternative factors that influence the acquisition of auditory processing skills of ESL learners in the multilingual South African context. There is a need for additional research with a larger sample size to determine the selective auditory attention abilities and speech-in-noise perception skills of ESL learners in government funded schools and from various socio-economic backgrounds.

Keywords

selective auditory attention; speech-in-noise perception; language experience; age of exposure; language proficiency; English second language; English first language; auditory processing; socio-economic status; multilingual country

List of tables

List of abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
BI	Binaural interaction
BILD	Binaural intelligibility level difference
CALP	Cognitive Academic Language Proficiency
CANS	Central auditory nervous system
CAP	Central auditory processing
(C)APD	(Central) Auditory Processing Disorders
COVID-19	Coronavirus Disease 2019
dB	Decibels
DIN	Digits-In-Noise
EFL	English first language
ESL	English second language
IQR	Interquartile range
LIC	Letter of informed consent
LoLT	Language of learning and teaching
N_0S_0	Diotic / in-phase
N_0S_π	Antiphasic / out-of-phase
SAAT	Selective Auditory Attention Test
SD	Standard deviation
SES	Socio-economic status
SNR	Signal-to-noise ratio
SRT	Speech reception threshold

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CHAPTER 1: Introduction and study rationale

The aim of this chapter is to introduce this study's research topic, as well as the relevance of the research to the field of Audiology. A critical discussion of the literature on the selective auditory attention and speech-in-noise perception of English second language (ESL) learners is provided.

1.1. Introduction

Multilingualism is a defining characteristic of the African continent, where roughly 2100 languages - which amounts to 30% of the world's languages - are spoken (Lewis, 2009). Generally considered to be among the most multilingual countries in the world, South Africa has 11 official languages that are recognized in its democratic constitution (Constitution of the Republic of South Africa, 1996). During the 2007 Annual School Survey, it was determined that 65.3% of South African learners are enrolled in English medium schools (South African National Department of Basic Education, 2010), yet less than 10% of these learners are English first language (EFL) speakers (Statistics South Africa, 2012). This implies that more than half of the learners in South Africa are ESL speakers and are not receiving education in their first language (Brock-Utne & Skattum, 2009; Heugh, 2009; Spaull, 2016). These learners are often labelled as educationally at risk or disadvantaged as a result of the linguistic transition they have to make, and often do not cope in the academic domain (Kapp, 2004).

It is accepted worldwide that language competence and proficiency play a fundamental role in literacy development and are basic to achieving academic success (Hay & Fielding-Barnsley, 2012; Hoff, 2006; Owens & Owens, 2012). Kotzé and Hibbert (2010) identified the use of English as the language of learning and teaching (LoLT) in schools, especially primary schools, as a major contributing factor to the underdevelopment of academic skills in South Africa. This corresponds with the relationship that has been found globally between the decreased use of a first language as the LoLT and the educational difficulties experienced by learners using a different language for learning (Pandor, 2006; Tabri et al., 2011).

Internationally, and especially in developing countries such as South Africa, numerous school-aged learners have inadequate English language proficiency to cope within formal academic settings (Nieman & Hugo, 2010; Taylor & von Fintel, 2016; Wildschut et al., 2016). In these academic settings language is often used without preceding context, which may result in unsuccessful academic learning for some of these learners (Taylor & von Fintel, 2016; Wildschut et al., 2016). It is widely recognized that academic learning takes place optimally in learners' first language, as second language learners often have insufficient vocabulary and Cognitive Academic Language Proficiency (CALP) to learn in the additional language (Webb et al., 2010; Wildschut et al., 2016). CALP refers to the dimension of language proficiency which is correlated with overall cognitive and academic skills, and it describes the use of language in decontextualized academic situations (Baker, 2006). It is essential for learners to develop significant CALP in order to attain sufficient language skills for speaking, listening, reading, writing and optimal academic performance (Cummins, 2008; Pretorius, 2002).

Additional language acquisition is evidently complex, with different processes influencing its progression (Vandergrift, 2004; Vandergrift & Goh, 2018). The ability to listen has a significant influence on language acquisition, and it has been identified as a crucial skill to have in order to acquire a second language and participate in discussions (Vandergrift, 2004; Yilmaz & Yavuz, 2015). Listening and understanding auditory information is not purely reliant on the physiological mechanisms of the ear, but also involves complex central auditory processing (CAP) abilities (Cole & Flexer, 2015). CAP may be described as the perceptual processing of auditory information in the central auditory nervous system (CANS) (American Speech-Language-Hearing Association [ASHA], 2005). Many mechanisms underlying auditory processing abilities or skills are included in CAP, such as binaural interaction (BI), which includes localization and lateralization skills, binaural release form masking, detection of signals in noise, as well as binaural fusion (ASHA, 2005; Bellis, 2011).

It is generally known that binaural hearing provides an advantage to a listener when listening to speech in the presence of background noise. This "binaural advantage", which leads to enhanced performance in various auditory tasks (Bellis, 2011), is the

result of BI. BI involves the processing of dissimilar information presented simultaneously to both ears (McCullagh & Bamiou, 2014). It is known as the auditory processing process underlying the ability to detect a signal in the presence of noise, and actively separates the signal from the background noise (Ferre, 2006), thus allowing speech-in-noise perception or the ability to perceive and comprehend speech in the presence of background noise (Holt & Lotto, 2010). Neural processes are employed in the process of speech perception to hear and understand speech through the perceptual mapping of speech signals. Speech signals are masked when noise is present in an acoustic environment, as the noise segments obscure the less profound portions of the signal and decrease the signal-to-noise ratio (SNR) (Rogers et al., 2006). Speech perception tends to deteriorate as the SNR decreases.

Certain factors, including language background variables (e.g., age of onset of acquisition, age of exposure to an additional language, language proficiency, etc.) may affect the comprehension of speech even in quiet conditions (Rogers et al., 2006). Comprehension can be further degraded when environmental factors, such as noise and reverberation, also come into play (Rogers et al., 2006). Understanding speech in the presence of background noise is a skill known to develop well into adolescence (Nelson et al., 2005). Children's exposure to and experience with a specific language also may affect their proficiency and in turn their ability to comprehend incoming speech signals in the additional language. Therefore, children who receive their education through their additional/second language appear to be at a distinct disadvantage when listening in classrooms where background noise and reverberation are inevitable (Nelson et al., 2005; Rogers et al., 2006).

It is of the utmost importance that educators be made aware of the influence of noise on speech perception abilities of ESL learners, so that they may strive to reduce classroom noise, increase speech intensity levels, and improve access to spoken language for these ESL learners (Nelson et al., 2005). Speech-in-noise testing is a measure that allows the tester to determine a learner's ability to function in classrooms and in daily life, as it focuses on speech perception in the presence of background noise. The testing environment created when administering the test simulates everyday listening environments, such as a classroom. Results then provide the

necessary information about a learner's functional performance in the typical classroom environment (Smits, Kapteyn & Houtgast , 2004; Smits, Goverts & Festen, 2013).

The South African Digits-In-Noise (DIN) test is a speech-in-noise test that can be utilised to assess a listener's ability to recognise speech signals in the presence of noise (Smits et al., 2013) by presenting digit triplets binaurally to measure the speech reception threshold (SRT) (Potgieter et al., 2016; Smits et al., 2004). Digits are familiar to learners from a young age and are amongst the first words that are learned and acquired in a second language. Therefore, digits are ideal for testing speakers for whom English is their second or third language (Smits et al., 2013).

When conducting the DIN test, the digit triplets are presented diotically, where the digits and the masking noise are introduced interaurally in phase (N_0S_0). For evaluating SRT, the use of a DIN test paradigm using digits that are phase inverted between the ears, while leaving the presentation of the masking noise in-phase (N_0S_π), has been shown to improve the DIN SRTs in normal hearing listeners and also to be sensitive in detecting different types of hearing loss (De Sousa et al., 2019). The improvement of SRT scores for N_0S_π relative to N_0S_0 presentation conditions are known as the binaural intelligibility level difference (BILD) (Hirsh, 1948; Licklider, 1948). Furthermore, a study by Wolmarans et al. (2021) validated the use of the DIN test on children from 7 years of age and identified increasing age as a predictor of improved SRT in both diotic and antiphasic listening conditions.

The ability of the CANS to extract spatial cues when a target sound and competing noise become spatially separated results in the emergence of a binaural release from masking (Kidd et al., 2010). The fact that speech can be unmasked by binaural release from masking, presented the possibility that BILD plays a role in the process of selective auditory attention (Bronkhorst, 2000; Licklider, 1948). Through the process of selective auditory attention, a specific input is extracted and focused on for further processing, while irrelevant or distracting information is simultaneously suppressed

(Cherry & Rubinstein, 2006; Strait & Kraus, 2011). Auditory attention plays an important role in an individual's orientation to environmental stimuli and ability to maintain an alert state in order to detect signals for subsequent detailed processing. Effective listeners have the ability to segregate different stimuli into different streams and subsequently decide which streams are most pertinent to them. This skill is essential for a learner to establish the academic foundations of language, literacy, and mathematics (Stevens & Bavelier, 2012).

Taking into consideration that the typical classroom environment overflows with auditory and visual distractions, the role of selective auditory attention and optimal speech-in-noise perception cannot be underestimated (American National Standards Institute, 2002; Strait & Kraus, 2011; Talcott et al., 2002). The distractions in the typical classroom create a challenging situation for a child who has to focus on the teacher's instructions. The auditory system needs to learn to adapt to a variety of listening conditions in order to extract specific information (Koopsman et al., 2018; Strait & Kraus, 2011; Talcott et al., 2002). A child's ability to focus on a target signal and suppress any competing noise is of great importance to teachers and clinicians; it ultimately forms a very important part of learning and communication (Dockrell & Shield, 2006; Flexer, 2004). This raises the question whether and to what extent BI plays a beneficial role when a child listens to speech in the presence of background noise. A study by Koopsman et al. (2018) showed that in order to understand speech in noisy settings, children need to be able to separate speech from noise by using binaural and other cues.

Cherry and Rubinstein (2006) compared monotic and diotic selective auditory attention abilities in children. In monotic presentation, stimuli are presented to one ear only. The study examined whether monotic and diotic presentations when conducting the Selective Auditory Attention Test (SAAT) produced homogenous results for listening to speech in noise. Results indicated that the scores for diotic presentation were significantly higher than the outcome for monotic presentation, with no significant difference between left and right ears. Furthermore, the results of the study showed that gathering information binaurally enhances selective auditory attention skills in

learners (Cherry & Rubinstein, 2006). When a learner can focus on the relevant information and extract the main concept of the message that was heard, in the presence of background noise, the quality of speech perception will be improved (Alain et al., 2005).

In addition to noise and developmental factors, a child's experience with a specific language may affect his or her ability to make sense of incoming speech stimuli (Chang et al., 2013; Nelson et al., 2005). Research on second language learning suggests that age and age-related factors such as age of exposure to an additional language, are major variables in the acquisition of a second language for learning in school (Collier, 1987b). As early as the 1980's, studies determined that age of exposure to a second language has a tremendous effect on a child's academic achievement. Collier (1987a), and later also Collier and Thomas (1988), analysed the length of time necessary for immigrants who arrived in the United States, whose schooling was exclusively in English after arrival, to achieve scores similar to those of native English speakers in reading, language arts, and other school modules. The studies were limited to those learners who had no previous exposure to English prior to their arrival in the United States. These immigrants who had arrived between the ages of 4 and 7 and had little or no schooling in their home language before immigration, required a minimum of 5 years to achieve the 50th normal curve equivalent on standardised tests. These findings provided evidence that second language proficiency and academic achievement are not accomplished at a rapid pace (Collier, 1987a; Collier & Thomas, 1988). Therefore, an earlier onset of exposure to the LoLT may impact ESL learners' abilities to perform in academic settings. It is thus necessary for a child to master the challenges experienced in the classroom environment, to become confidently literate in English as their second or third language, in order to participate in classroom discussions and eventually achieve academic success (Hugo & Nieman, 2010).

Considering the challenges that an ESL learner may experience, additional research is warranted to determine how ESL learners in a multilingual country such as South

Africa perform in the various domains of CAP in order to suggest guidelines for facilitating teaching and learning in the classroom.

1.2. Problem statement and study rationale

Despite evidence from research both in Africa and in other countries across the world that education in a child's first language is critical for true learning to occur at a deep and profound cognitive level, English remains the chosen medium of education in many countries (Ndimande-Hlongwa & Wildsmith-Cromarty, 2010). English is also the preferred language of instruction in the majority of South African schools, especially in primary schools. This has been identified as a factor which contributes to the underdevelopment of learners' academic achievements (Henning, 2012; Kotzé & Hibbert, 2010; Taylor & von Fintel, 2016). Taylor and von Fintel (2016) found in their study that due to the fact that ESL learners have hardly ever developed the required language proficiency to achieve academic learning successfully, these learners experience significant difficulties understanding educational information in their second and/or third language (Moonsamy & Kathard, 2015).

In order for learners to perceive and understand a verbal message in the classroom environment, it is necessary for them to attend to a signal whilst simultaneously suppressing the competing noise. ESL learners experience additional challenges – in addition to the fact that they experience problems with the language of instruction, they have to process it in a non-optimal listening environment (Kollmeier et al., 2015). These learners may also not have the required contextual and background knowledge regarding topics discussed in the classroom, so that the demand on them is much higher than on EFL learners. The ability to attend to a specific target stimulus whilst suppressing competing noise, is of the utmost importance for learning and communication (Isbell et al., 2016; Strait & Kraus, 2011).

To date very few studies have been conducted to investigate the selective auditory attention abilities and speech-in-noise perception (especially in an antiphasic listening condition) of young ESL learners in a multilingual country. Given the range of auditory demands with which learners are faced in the typical classroom environment, along

with the importance of these skills to achieve academic success, additional research is warranted that may support the development of strategies that will be effective in addressing the challenges these learners face in the South African context. Considering that learners are required to develop proficiency in their LoLT for formal or academic situations at a young age, further research for this population is warranted. The aim of the study, therefore, was to determine the selective auditory attention abilities and speech-in-noise perception of ESL learners in a multilingual country.

CHAPTER 2: Research method

The aim of this chapter is to outline the procedure and methods that were utilized in this study. The chapter will provide a comprehensive description of the research design that was used in order to determine the selective auditory attention abilities and speech-in-noise perception of ESL learners aged seven-to-eight years, using diotic and antiphasic listening conditions. The aim and objective of the study will be discussed, as well as the ethical considerations, study participants, and data collection and analysis procedures.

2.1. Study objective

The aim of the study was to determine the selective auditory attention abilities and speech-in-noise perception of seven-to-eight-year-old ESL learners in private schools in the Tshwane District of Gauteng, South Africa – a multilingual context.

2.2. Research design

A quantitative, descriptive, comparative cross-sectional research design was selected for this study. A quantitative research paradigm involves using formalized tests and measuring instruments to specify the characteristics of data accurately and objectively in numerical terms (Maxwell & Satake, 2006). The aim of quantitative research involving human participants is often to determine the correlation and relationship between two participant groups in a population, by means of numerical and mathematical methods (Watson, 2015). In the current study two independent participant groups were compared with regard to their selective auditory attention abilities and speech-in-noise perception using the Mann-Whitney test (Field, 2018). The South African DIN test (De Sousa et al., 2019; Potgieter et al., 2016) and the SAAT (Auditec, 2015) allowed for speech-in-noise perception and selective auditory attention abilities to be quantified by providing numerical values for the participants' scores on these tests.

The purpose of descriptive research is to describe a group of people, a phenomenon, or an event (Nassaji, 2015; Salkind, 2010). Descriptive research is the primary step in understanding social problems, as it describes who is experiencing the problem, the extent of the problem, and possibly also the duration of the problem (Blaikie & Priest, 2019; Salkind, 2010). The current study employed a cross-sectional research design, as data was collected at a single point in time (Maxwell & Satake, 2006).

Two groups of participants were selected to participate in the data collection process, which resulted in a descriptive comparative study design (Leedy & Ormrod, 2013). The research group included ESL learners, whereas the control group consisted of EFL learners, all between the ages of seven and eight years.

2.3. Research ethics

Specific ethical aspects were taken into consideration to recognize and safeguard the interests of research participants in a variety of contexts, particularly since children were the focus of the research (Department of Health, 2015; Leedy & Ormrod, 2013). Ethical clearance was obtained from the Research and Ethics Committee (RESCOM) of the Department of Speech-Language Pathology and Audiology, and also from the Faculty of Humanities' Research Ethics Committee (HUM006/0320) (Appendix A). Data collection commenced once written consent had been obtained from the principals of the three schools where data collection took place (Appendix B), as well as from the parents and/or guardians of the learners who participated in the study (Appendix C). Assent was also obtained from the participants (Appendix D).

The ethical considerations that were incorporated in this study, in accordance with the South African Health Act No. 61 (National Health Act, 2004), were as follows:

2.3.1. Informed consent

Informed consent was obtained from the principals of three private schools before the start of the research study (Appendix B). The principals of the schools were each

provided with an information letter (Appendix B) that explained the request for learners from the school to act as voluntary participants.

Relevant information regarding the study was provided to the participants' parents and/or guardians in the letter of informed consent (LIC) (Appendix C), in order to ensure that they were able to make an informed decision when they provided consent. The written consent from the participants' parents and/or guardians is evidence that their participation in the research study was voluntary and based on an informed choice.

Information was provided to each participant through the use of pictures, as well as a verbal explanation. Child assent was obtained from the under-aged participants by the participant drawing a cross over "yes" or "no" after questions regarding the procedure were asked in order to ensure that each participant understood what was expected of him/her (Appendix D). This was done before the commencement of the study. Participants were given the right to withdraw at any time during the study without any negative consequences (Leedy & Ormrod, 2013).

2.3.2. Beneficence and non-maleficence

The deliberate infliction of harm on participants is forbidden by this principle, as well as by the University of Pretoria's code of ethics for researchers (Draucker et al., 2009; University of Pretoria, 2018). The researcher ensured maximum benefit and minimal harm or risk whilst conducting the research study. It was explained in the LIC (Appendix C) that the participants would be protected from any physical or psychological harm and that he/she would be treated in a respectful manner. The comfort and safety of the participants would also be ensured. No dangerous or harmful procedures were used by the researcher, as indicated and explained in the letter to the parents and/or guardians (Appendix C).

Should any abnormalities be observed during the participant selection process, the researcher provided feedback to the parents and/or guardians (Appendix E) and also made an appropriate referral for further diagnostic tests and/or intervention to the Department of Speech-Language Pathology and Audiology at the University of Pretoria.

2.3.3. Privacy and confidentiality

Privacy refers to who has access to the information pertaining to the participants (Parker, 2001). Confidentiality, on the other hand, refers to the appropriate measures implemented in order to prevent the disclosure of identifying information of any of the participants at any time during or after the research study (University of Pretoria, 2018). Confidentiality regarding each participant's identity, personal information, and results was assured by the researcher. Participants were assigned a unique code to ensure that no identifying information about the participant was disclosed during the data analysis. All research data obtained will be stored on the University of Pretoria's repository in electronic format for a minimum period of 15 years.

2.3.4. Honesty and plagiarism

The results of the study were reported honestly and were not altered. The research report and article are not intentionally misleading or deceiving. The research study and dissertation are the researcher's own original work. Secondary material was meticulously acknowledged and referenced according to the American Psychological Association (APA) 7th edition referencing guidelines, which is in accordance with the University of Pretoria's specifications. The research study also adhered to the University of Pretoria's Policy on Plagiarism. A plagiarism declaration of originality can be found at the beginning of the document.

2.4. Research setting

The study was conducted at three private schools in the Tshwane district, Gauteng province of South Africa. Convenience sampling was used as the schools were

selected based on their willingness to participate in the research study. The use of private schools in this study was intentional, to ensure similar socio-economic status (SES) of the learners and minimize potential external variables regarding their language exposure (Landsberg et al., 2016). The testing was conducted during school hours within a relatively quiet environment. Conference rooms, halls, or offices were made available by the specific schools for interviewing the participants and testing was also conducted there.

2.5. Sampling method

As the participants were selected for a specific purpose at schools that were readily available, a non-probability purposive sampling method was used (Leedy & Ormrod, 2005; Setia, 2016). Non-probability purposive sampling meant that a smaller group of key individuals could be selected to represent a larger group (Maxwell & Satake, 2006). EFL learners, as well ESL learners, were chosen purposively from the three English private schools. The research group consisted of the ESL participants, while the control group consisted of the EFL participants.

2.6. Participants

All of the participants in both the EFL and the ESL group had to adhere to the selection criteria (see below). Participants were classified as belonging to either the EFL or the ESL participant group based on their first language (their mother tongue). A first language is identified as the language to which a person had been exposed since birth and which was learned within the critical period of language development (Saniei, 2011). If the participant's first language was English (i.e., English was spoken at home), he/she was classified as an EFL participant. If the participant's first language was a language other than English, the participant was categorized in the ESL participant group. Forty (40) participants between the ages of seven and eight years were included in the study. The research group consisted of 20 ESL participants, with a control group of 20 participants with English as their first language.

2.6.1. Participant selection criteria

The following criteria were used to select the participants.

- Only learners between the ages of seven and eight (7 years 0 months – 8 years 11 months) were selected for this research study (Bellis, 2004). This age category was chosen to ensure that adequate neural maturation had occurred and that the participants had sufficient capabilities to provide reliable and valid responses (Bellis, 2004; Schafer et al., 2013). It is also at this age where language plays a significant role in the development of literacy skills.
- Normal peripheral hearing sensitivity as well as intact middle ear functioning were required for the testing of central auditory processing (ASHA, 2005; British Society of Audiology, 2007; Dawes et al., 2008). These factors were of significant importance in order to ensure the reliability and validity of the assessment. This criterion implied the following:
    - Otoscopy should indicate normal results bilaterally – no abnormalities detected, nor excessive cerumen that could occlude the outer ear canal.
    - Behavioural pure tone screening thresholds obtained at 20 decibels (dB) or lower at the following frequencies: 1000, 2000 and 4000 Hz (Swanepoel et al., 2014).
    - Acoustic immittance measurements obtained should be normal: Type A tympanograms with a middle ear pressure of -150 to +150 daPa, static compliance of 0.3 to 1.75 ml, and an ear canal volume of 0.8 to 1.0 ml had to be obtained bilaterally. Acoustic reflex thresholds between 70 – 95 dB SP at 500 – 4000 Hz were required (Hind et al., 2011; Katz, 2014).

- Participants were excluded from the research study if they presented with the following characteristics:
    - Participants who presented with behavioural pure tone thresholds of higher than 20 dB at 1000, 2000, and 4000 Hz (Margolis et al., 2015). If a prospective participant presented with a possible hearing loss, he/she was referred for further diagnostic testing to the Department of Speech-Language Pathology and Audiology at the University of Pretoria.
    - When participants were reported to suffer from recurrent otitis media, they were excluded from the research study. Chronic otitis media has

been linked to central auditory processing deficits, even after the otitis media has been resolved or cleared up and the hearing has returned to normal hearing sensitivity levels (Chermak et al., 1999; Khavarghazalani et al., 2016; Moore, 2007). Information regarding the history of otitis media was obtained from the case history questionnaire (Appendix F).

- Participants who presented with Attention Deficit Hyperactivity Disorder (ADHD), any learning disabilities, or head trauma, were not included in this research study. This was determined by a question included in the case history questionnaire (Appendix F). Disorders or disabilities, as mentioned above, may present with similar symptoms to (Central) Auditory Processing Disorders [(C)APD] and sometimes overlap (Lanzetta-Valdo et al., 2017). In the case where a learner presented with abnormal results and the researcher suspected a possible diagnosis of the abovementioned conditions, he/she was referred to the relevant disciplines for an assessment and/or further intervention.

2.6.2. Material and apparatus for participant selection

The material and apparatus outlined in Table 1 were utilised for participant selection in this research study.

Table 1: Summary of materials and apparatus for participant selection

Material and apparatus	**Description and motivation**
Case history questionnaire (Appendix F)	Information on the participant's history of middle ear infections, hearing loss, medication use, and academic performance was obtained. The information supplied by the parents and/or guardians was also used as an indication of the level of English to which the participant had been exposed, in order to determine whether the participant is an EFL or ESL learner.
Welch Allen Pocket Scope Otoscope with reusable specula	A visual examination of the external ear canal and the tympanic membrane was conducted to ensure that no abnormalities or excessive cerumen in the external ear canal were present. If excessive cerumen was observed, a referral was made to a general practitioner or an ear, nose, and throat (ENT) specialist.

Table 1: Summary of materials and apparatus for participant selection	
Cardinal Health GSI 39 Auto Tymp: Comprehensive middle ear tympanometry. *(GSI 39 Auto Tymp is calibrated annually, according to protocol. Ref. ANSI S3.6 / ISO 389)*	Acoustic immittance testing was performed to examine the participants' middle ear functioning. Participants with middle ear pathologies were excluded from this research study. When participants' tympanometry results were abnormal (Type A_d, A_s, B, or C), a referral was made for a diagnostic tympanometry test at an audiologist. Acoustic reflex thresholds between 70 – 95 dB SP at 500 – 4000 Hz were required (Hind et al., 2011; Katz, 2014).
HearScreen™: Smartphone hearing screening application *(Swanepoel et al., 2014)*	The hearing thresholds of the participants were determined using air conduction screening at 1000, 2000, and 4000 Hz.

2.6.3. Participant selection procedure

After ethical clearance and permission from the schools had been obtained, potential participants were selected by the researcher. A LIC and case history questionnaire were sent to be completed by each of the participants' parents and/or guardians via the school. After informed consent had been granted, the participants were selected purposively according to the inclusion and exclusion criteria and assigned to the research group (ESL learners) or the control group (EFL learners). In accordance with previous research (Morrow et al., 2005), personal information was obtained from the case history questionnaires (Appendix F), to determine which of the participants met the inclusion criteria. If the inclusion criteria were not met, the participant was excluded from the research study. In order to restrict the degree to which the EFL and ESL groups differed, a standard procedure was implemented to match the samples by pairing them according to specific characteristics (Maxwell & Satake, 2006).

Testing was conducted during school hours in a relatively quiet environment, for example the staff room or a quiet classroom. Otoscopic examinations and tympanometry were performed in order to establish the participants' outer and middle ear functioning. Behavioural pure tone audiometric screening was conducted by the researcher, according to the child protocol for hearing screening (Ross et al., 2008). A letter was given to the participants' parents and/or guardians to indicate if the specific participant passed the hearing screening or not (Appendix E). Should the participant

have failed the hearing screening, a referral was made for further diagnostic assessment.

2.6.4. Participant description

A description of the learner participants is provided in Table 2:

Table 2: Description of learner participants in this research study

Participant characteristics	EFL group (n=20)	ESL group (n=20)
Age in years		
Mean (SD)	7.35 (0.49)	7.70 (0.47)
Minimum	7.00	7.00
Maximum	8.00	8.00
Gender		
Female	n=9 (45%)	n=12 (60%)
Male	n=11 (55%)	n=8 (40%)
Home language		
English	n=20 (100%)	
isiXhosa		n=2 (10%)
isiZulu		n=1 (5%)
Sepedi		n=7 (35%)
Sesotho		n=3 (15%)
Setswana		n=6 (30%)
Tshivenda		n=1 (5%)
Exposure to English via		
Caregivers	n=12 (60%)	n=10 (50%)
Television	n=18 (90%)	n=18 (90%)
Books	n=16 (80%)	n=16 (80%)
Radio	n=12 (60%)	n=9 (45%)
Family and friends	n=14 (70%)	n=14 (70%)
Nursery/day care	n=17 (85%)	n=18 (90%)
Grade R	n=9 (45%)	n=15 (75%)

This table describes the characteristics of the participants used in this study.

Each group included in the study consisted of 20 participants. The nonparametric Mann-Whitney (MW) test and Shapiro-Wilk test (Field, 2018) were run, instead of the parametric t-test, to test for statistically significant differences between the ages of the control and research groups. There was no statistically significant difference between the ages in the research group and the control group (MW = 130.000, p=0.056; Shapiro-Wilk = 0.636, p<0.001). The most prominent home languages of the ESL group were Sepedi and Setswana. The majority of the participants (n=35) had attended an English nursery school/day care. Sixty percent of the participants (n=24) were exposed to English in an educational setting from Grade R. It is important to take

note that not all the participants' parents and/or guardians filled in each column in the case history questionnaire regarding age of exposure to English through various sources. A larger number of participants in the EFL group were exposed to English through their caregiver (n=12) than in the ESL group (n=10). The differences in the participants' exposure to English are presented in Table 3.

Table 3: Age of exposure to English *(in years)*

Particulars regarding exposure to English	EFL (control group)		ESL (research group)		Mann-Whitney	p-value
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)		
Mean age exposed to English	1.81 (1.53)	1.86 (2.94)	2.82 (0.89)	2.67 (1.30)	94.000	0.019*
Via caregivers	0.00 (0.00)	0.00 (0.00)	1.30 (1.04)	1.00 (1.63)	6.000	<0.001*
Via family and friends	0.50 (1.40)	0.00 (0.00)	1.93 (1.00)	2.00 (1.25)	27.500	0.001*
Via books	1.41 (1.92)	0.50 (2.50)	3.30 (2.20)	3.50 (3.75)	64.000	0.014*
Via television	1.39 (1.26)	1.25 (3.00)	1.70 (0.97)	2.00 (1.00)	135.000	0.383
Via radio	1.42 (2.31)	0.00 (2.50)	2.30 (1.54)	2.00 (2.50)	29.000	0.068
Via nursery/day care	2.01 (1.71)	2.00 (3.13)	2.56 (1.04)	2.50 (1.25)	114.000	0.190
Via Grade R	5.78 (0.44)	6.00 (0.50)	5.73 (0.46)	6.00 (1.00)	64.500	0.812

* Statistically significant at a 5% level of significance

The Mann-Whitney test confirmed that the mean age of exposure did not differ statistically significantly between the EFL and the ESL group for exposure via television (p=0,383), radio (p=0,068), nursery/day care (p=0,190) and Grade R (p=0,812). However, statistically significant differences were found between the EFL and the ESL group for exposure via caregivers (p<0.001), family and friends (p=0,001) and books (p=0,014). In addition, the mean age of exposure was computed (by averaging all the measures of exposure), and the difference between the EFL and ESL groups (p=0,019) was also found to be statistically significant. In all cases where statistically significant differences were found, the mean and median ages of ESL were significantly higher than the mean age for EFL, indicating that the ESL learners were only exposed to the different media when they were older. All of the participants' otoscopy results indicated normal outer ear canal structures. Normal acoustic immittance results as indicated by a type A tympanogram, as well as acoustic reflex

thresholds between 70 and 95 dB SP at 500 – 4000 Hz, were obtained by all the participants (Hind et al., 2011; Katz, 2014). A pass result was obtained by all participants on the HearScreen™ application.

2.7. Data collection

The material, apparatus, and procedures outlined in 2.7.1. and 2.7.2. were used for data collection in this research study.

2.7.1. Material and apparatus for data collection

The following material and apparatus were utilised for data collection in this research study:

2.7.1.1. The Selective Auditory Attention Test

The SAAT is a monaural low-redundancy speech test that was developed as a speech-in-competing-message test for the early identification of learners who may have a problem attending to auditory stimuli, especially in the presence of background noise (Auditec, 2015). Cherry and Rubinstein (2006) established that binaural presentation when using the SAAT resulted in better performance due to the binaural advantage when listening to stimuli binaurally. Therefore, during commencement of data collection in the current study, the SAAT was also presented binaurally. It is of substantial importance to master the ability to attend to a target signal and suppress any competing noise, in order to develop adequate learning and communication skills (Strait & Kraus, 2011). The SAAT was developed to identify children who may present with possible (C)APD, and who require further in-depth testing (Cherry & Rubinstein, 2006). The SAAT is a closed-set picture-pointing task, consisting of two parts: two lists of Word Intelligibility by Picture Identification (WIPI) words in quiet (lists one and three), and two lists of WIPI words presented in a competing noise (lists two and four). Each of the four lists consists of 25 monosyllabic words (Cherry & Rubinstein, 2006). The competing noise for the latter two lists comprised of a speaker telling a story that was identified by children to be interesting, causing a semantic distraction. The WIPI words

and competing story were recorded at a signal-to-competition ratio of 0 dB, which increases the test's difficulty (Auditec, 2015).

The SAAT was analysed by Chermak and Montgomery (1992), and it was confirmed to be clinically viable. This test was designed to be quick and easy to administer, taking only eight minutes to both conduct and score (Cherry & Rubinstein, 2006). It was also determined that the SAAT has high inter-list reliability (Chermak & Montgomery, 1992; Cherry, 1980), as well as sufficient test-retest reliability (Cherry, 1980).

2.7.1.2. Digits-in-Noise Test

The ability to recognise speech in the presence of background noise can be assessed using the DIN test (De Sousa et al., 2019; Potgieter et al., 2016; Smits et al., 2013). One benefit of this test is that highly familiar spoken words, so-called digit-triplets, are presented as speech stimuli (Potgieter et al., 2016). The DIN assesses the bottom-up process of speech recognition in the presence of background noise (Smits et al., 2013). As simple, familiar words of digit speech stimuli in a closed set paradigm are used, the linguistic demand required from the listener is decreased, and it can therefore be utilized as a diagnostic measure to determine the auditory speech recognition abilities in the presence of background noise (Smits et al., 2013). It has been established that when SRTs are determined for ESL listeners, a closed-set speech test should be used rather than an open-set speech test (Kollmeier et al., 2015). Digit-triplets that are presented as speech material (Potgieter et al., 2016), are "counting words" known by children from a young age and are amongst the first words that are learned and acquired in a second language (Smits et al., 2013). Therefore, digit pairs are ideal for testing speakers whose second or third language is English (Koopsman et al., 2018) while everyday speech-in-noise environments are approximated (Jansen et al., 2010; Smits et al., 2013; Zokoll et al., 2012).

When the DIN test is conducted, the digit triplets are presented diotically, where the digits and the masking noise are introduced interaurally in phase (N_0S_0). However, when evaluating the SRT, the use of a DIN test paradigm using digits that are phase

inverted between the ears, while leaving the presentation of the masking noise in-phase (N_0S_π), has been shown to improve the DIN SRTs in normal hearing listeners, as well as to be sensitive in detecting different types of hearing loss (De Sousa et al., 2019). The improvement of SRT scores for N_0S_π relative to N_0S_0 presentation conditions are known as the binaural intelligibility level difference (BILD) (Hirsh, 1948; Licklider, 1948), which was also calculated for each participant. Furthermore, a study by Wolmarans et al. (2021) validated the use of the DIN test on children from 7 years of age and identified increasing age as a predictor of improved SRT in both diotic and antiphasic listening conditions.

2.7.2. Procedures for data collection

The SAAT and the DIN test were performed during one individual sitting for each participant. The order in which these tests were administered was alternated in order to avoid order effects (Kendall, 2003). A break was taken between testing if necessary. Both the research group (ESL learners) and the control group (EFL learners) were assessed in the same manner, time frame, and setting. All the data collected from the formal evaluations were stored for record-keeping and analysis in Excel spreadsheets.

2.7.2.1. Procedure of the Selective Auditory Attention Test

The SAAT consists of a closed-set picture-pointing task (Cherry & Rubinstein, 2006). The test requires the use of the four lists used in the WIPI test, and each of the four lists consists of 25 monosyllabic words (Cherry & Rubinstein, 2006). The SAAT was conducted in a quiet setting through headphones at a comfortable listening level. The comfortable listening level was held constant at approximately 50 dB HL for all participants (Aarabi et al., 2016; Rahman et al., 2011). Participants were requested to indicate the corresponding picture on each individual page of the WIPI test by pointing to it as the word was heard over the headphones. The SAAT was scored in terms of the number of correct responses out of 25. Four percent was given for each word correctly identified, and a percentage of correct scores was totalled for each of the four lists. This percentage was recorded on a summarised data collection record form (Appendix G). A score of less than 88% on the wordlists read in quiet invalidated the

entire test and therefore precluded administration of the word lists embedded in a semantic distractor. These participants were excluded from participation.

2.7.2.2. Procedure of the Digits-In-Noise Test

The DIN was introduced binaurally using diotic and antiphasic stimulus presentations on a smartphone with headphones in a quiet setting (De Sousa et al., 2019). In both listening conditions, participants were requested to press the numbers that were heard on the keypad (Potgieter et al., 2016). The first digit-triplet was presented to the participants at an intensity that was based on their selected comfortable listening level. After the response was entered on the keypad, the following digit-triplet was presented automatically at a 2 dB higher SNR for an incorrect response, or at a 2 dB lower SNR for a correct response. A digit-triplet was only judged as correct when all three digits had been entered correctly (Potgieter et al., 2016). The SRT was calculated as the average SNR of the last 19 of 23 triplets presented in total (De Sousa et al., 2019; Potgieter et al., 2016). Results for both diotic and antiphasic listening conditions were then recorded on the summarised data collection record form (Appendix G). The BILD, which represents the difference in SNR between diotic and antiphasic results obtained in each group respectively, was then determined. The BILD was also recorded as dB SNR.

2.7.2.3. Coronavirus Disease 2019 (COVID-19) protocol

Data collection was conducted during the COVID-19 pandemic. Precautionary measures were implemented throughout, in order to ensure safety and protection to both the researcher and the participant while the test procedure was administered. These precautionary measures were communicated to the parents and/or guardians in the LIC (Appendix C). Precautions were as follow:

- If the participant/researcher presented with any symptoms of COVID-19 or was feeling ill a day before the scheduled dates for testing, it had to be communicated and the appointment was cancelled and rescheduled.
- If the participant/researcher showed symptoms or seemed ill when arriving at the testing station, the session was immediately cancelled and did not take place.

- A short questionnaire covering possible symptoms was presented verbally to the participant to be completed (Appendix H).
- The participant's temperature was measured with a thermometer to determine if he/she had a fever.
- The wearing of masks was compulsory for all parties involved during testing.
- No physical contact was allowed when greeting.
- A distance of at least one meter was maintained as far as possible.
- The participant's hands were sanitized with the available sanitizing products upon entering the session.
- Gloves were available for use.
- At the end of the session, the participant's hands were sanitized again before he/she returned to class.

2.8. Data analysis

All the data obtained during the study were edited, coded, and categorized. Raw data were stored in a Microsoft Excel spreadsheet in a coded format. A statistician was consulted to process and analyse the data by means of the software G*Power version 3.1.9.4. (Faul et al., 2007) for the power analysis and Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corporation, 2019) for all other statistical analyses.

Statistical analysis of the scores obtained in the SAAT and DIN test during data collection was performed. The results for the EFL group and for the ESL group were then compared in terms of the mean and median as well as the standard deviation (SD) and interquartile range (IQR) for each group. When comparing two independent groups (the control and the research group), comparisons are done by using the parametric independent samples t-test or the nonparametric Mann-Whitney test depending on the sample size and whether or not the data is normally distributed (Field, 2018). Nonparametric tests are used for small sample sizes (typically $n<30$) or when the data is not normally distributed, whereas parametric tests are used for large sample sizes (typically $n\geq30$) when data is normally distributed. Normality was tested for using the Shapiro-Wilk test (Field, 2018), and since the p-values for the continuous variables were less than 0.05, it was determined that the data was not normally

distributed and, accordingly, nonparametric tests were used. Using the software G*Power, the achieved power for the Mann-Whitney test for comparing two independent groups of size 20 each equals 0.861, which is excellent as the ideal power should be 0.8 or higher (Cohen, 1988).

2.9. Reliability and validity

Reliability refers to the consistency and accuracy of a measure in the research study (Heale & Twycross, 2015). This means that if the same test performed on a participant more than once, responses should be approximately the same each time. Reliability in this research study was ensured by using equipment that was calibrated according to the SANS standards for testing. An identical test battery was carried out on all participants, which also supported the reliability of the research. To ensure that the results that were obtained were accurate, participants received comprehensive instructions to make sure that they fully understood what was expected from them and how they needed to respond. The tools that were utilized in this research study were published formal outcome measures, which increased the reliability of the study.

Validity can be defined as the degree to which an instrument that is used to obtain data, is correctly measuring the intended data (Heale & Twycross, 2015). Data was collected by the researcher with the aid of different tests. The validity of the test results could be confirmed when any concurrences were established between the tests. Validity of the SAAT and DIN test has been established through previous research (Chermak & Montgomery, 1992; De Sousa et al., 2019; Potgieter et al., 2016; Wolmarans et al., 2021).

The SAAT and DIN test are standardized assessment tools with a low linguistic demand, as only single words and digits are used, and the outcomes were therefore not affected by language differences (Auditec, 2015; Potgieter et al., 2016; Smits et al., 2004). The assessment tools that were used in this research study are therefore valid and appropriate to be used for research in the South African context.

CHAPTER 3: Research article

The article was submitted to the International Journal of Pediatric Otorhinolaryngology for review (Appendix I). The article was prepared according to the journal's specification and therefore the formatting differs from that of the dissertation.

Effects of language experience on selective auditory attention and speech-in-noise perception among English second language learners: preliminary findings

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Abstract

Objective: The purpose of the study was to examine the effects of language experience on selective auditory attention and speech-in-noise perception in English Second Language (ESL) learners aged seven to eight years.

Method: A quantitative, descriptive, comparative cross-sectional research design was used to determine the effect of age of exposure to English on the selective auditory attention abilities and speech-in-noise perception skills of 40 children with normal hearing in first or second grade (aged seven to eight years). The control group comprised of 20 English first language (EFL) learners (mean age = 7.35 years ± 0.49) and the research group included 20 second language learners (mean age = 7.70 years ± 0.47). In order to compare the control and research groups with respect to the age of exposure to English through various sources, the Mann Whitney test was used. Information regarding the age of exposure was gathered by a case history questionnaire, completed by the parents/guardians of the participants. The Selective Auditory Attention Test (SAAT) and Digits-in-Noise (DIN) test were performed in one sitting.

Results: No statistically significant differences between the EFL and ESL groups were found for the SAAT and DIN. However, a statistically significant difference was obtained between the SAAT lists 1 and 3 & the DIN: diotic listening condition for the ESL group only (r_s= -0.623; p=0.003). The difference between the EFL and ESL groups in the mean age of exposure to English was statistically significant (p=0,019), with mean age of exposure to English in the ESL group (mean age = 2.82 ± 0.53) being higher than the mean age of exposure in the EFL group (mean age = 1.81 ± 1.53). However, this difference did not influence the results of the SAAT and DIN significantly.

Conclusion: The main finding was that selective auditory attention and speech-in-noise perception were not significantly affected in the ESL learners who participated in the study – learners who were recruited from private schools located in an urban area and thus from higher socio-economic status (SES) households. There is a need for additional research with a larger sample size to determine the selective auditory attention abilities and speech-in-noise

perception skills of ESL learners in government funded schools located in rural areas and from various socio-economic backgrounds.

Keywords: selective auditory attention; speech-in-noise perception; language experience; age of exposure; English second language; English first language

1. Introduction

Multilingualism is a defining characteristic of the African continent, where roughly 2100 languages - which amounts to 30% of the world's languages - are spoken (Lewis, 2009). Generally considered to be among the most multilingual countries in the world, South Africa has 11 official languages that are recognized in its democratic constitution (Constitution of the Republic of South Africa, 1996). Majority of the schools in South Africa follow one of two different monolingual educational programmes. In the first type, the child's first language is used as the language of instruction (i.e., English – EFL learner), and additional languages are taught as subjects. In the second type monolingual programme, the child's second (or third) language is used as the language of instruction (i.e., English – ESL), and other languages are taught as subjects, as in the case of the majority of learners in South Africa. During the 2007 Annual School Survey, it was determined that 65.3% of South African learners are enrolled in English medium schools (South African National Department of Basic Education, 2010), yet less than 10% of these learners are English first language (EFL) speakers (Statistics South Africa, 2012). This implies that more than half of the learners in South Africa are English second language (ESL) speakers who are not receiving education in their first language (Brock-Utne & Skattum, 2009; Heugh, 2009; Spaull, 2016). These learners are labelled as educationally at risk or disadvantaged as a result of the linguistic transition they have to make, and often do not succeed in the academic domain (Kapp, 2004).

It is widely accepted that language competence and proficiency play a fundamental role in literacy development and are basic to achieving academic success (Hay & Fielding-Barnsley, 2012; Hoff, 2006; Owens & Owens, 2012). Internationally, and especially in developing countries such as South Africa, numerous school-aged learners have inadequate English language proficiency to succeed within formal academic settings (Nieman & Hugo, 2010; Taylor & von Fintel, 2016; Wildschut et al., 2016). Kotzé and Hibbert (2010) identified the use of English as the language of learning and teaching (LoLT) in schools, especially primary schools, as a major contributing factor to the underdevelopment of academic skills in South Africa (Kotzé & Hibbert, 2010). There is adequate proof to support the reality that language development is influenced by auditory processing skills (Sharma et al., 2009; Wible et al., 2005) – a significant challenge exists in attempting to separate the influence of auditory processing on language processing and academic performance (Richard, 2019). Therefore, since learning takes place in English, the second (or third) language of many South African learners, these learners need to develop their auditory processing skills as rapidly and as comprehensively as possible in order to process the additional language as the LoLT (Bovo et al., 2018).

Research on second language learning suggests that age and age-related factors such as age of exposure to the additional language are major variables in the acquisition of a second language for learning in school (Collier, 1987b). As early as in the 1980s, studies determined that age of exposure to a second language has a significant effect on a child's academic achievement. The majority of urban listening environments are clamorous, and a substantial proportion of individuals must function in these environments every day, experiencing the pressure of having

to perceive speech in their second language (Kousaie et al., 2019). While the typical classroom environment overflows with abundant auditory and visual distractions (American National Standards Institute, 2002; Strait & Kraus, 2011; Talcott et al., 2002), the influence of noise and reverberation on speech perception cannot be underestimated (Nelson et al., 2005). In addition to noise and reverberation, a child's familiarity with a specific language also affects his or her ability to make sense of incoming speech stimuli (Chang et al., 2013; Nelson et al., 2005). Therefore, children learning in their additional/second language appear to be at a distinct disadvantage when listening in classrooms where background noise and reverberation are inevitable (Nelson et al., 2005; Rogers et al., 2006).

In order for learners to perceive and understand a verbal message in the classroom environment, it is necessary for them to attend to a signal whilst simultaneously suppressing the competing noise. ESL learners experience even further challenges – in addition to the fact that they experience problems with the language of instruction, they have to process it in a non-optimal listening environment (Kollmeier et al., 2015). Auditory processing abilities, such as selective auditory attention and speech-in-noise perception, are important skills for school-age children to master as these competencies support learning in noisy classroom environments. Selective auditory attention means that a specific input is extracted and focused on for further processing, whilst irrelevant or distracting information such as noise is simultaneously suppressed (Cherry & Rubinstein, 2006; Strait & Kraus, 2011). Selective auditory attention plays an important role in an individual's orientation to environmental stimuli and in maintaining an alert state in order to detect signals for subsequent detailed processing. Competent listeners have the ability to segregate different stimuli into different streams and subsequently decide which streams are most pertinent to them. This skill is crucial for speech perception in noise.

Noise masks and interferes with selective attention to a primary stimulus (Bovo et al., 2018). A study by Koopsman et al (2018) showed that in order for children to understand speech in noisy settings so that they can follow and participate in classroom discussions, children need to be able to separate speech from noise (Koopsman et al., 2018). The impact of selective auditory attention and optimal speech-in-noise perception on academic achievement of ESL learners cannot be disregarded. If educators are made aware of the influence of noise on speech perception abilities of ESL learners, they may realize the importance of reducing classroom noise and increasing speech intensity levels in order to improve access to spoken language for these ESL learners (Nelson et al., 2005).

Despite evidence from research both in Africa and in other countries across the world that education in a child's first language is critical for true learning to occur at a deeper and profound cognitive level, English remains the chosen medium of education in many countries (Ndimande-Hlongwa & Wildsmith-Cromarty, 2010). To date, few studies have been conducted to investigate the impact of language proficiency on selective auditory attention abilities and speech-in-noise perception in young ESL learners in a multilingual country. Given the range of auditory demands with which learners are faced in the typical classroom environment, along with the importance of auditory skills for achieving academic success, additional research is warranted that may support the development of effective strategies for addressing the challenges these learners face in the South African context. Therefore, the purpose of the study was to examine the effect of language experience on selective auditory attention and speech-in-noise perception of ESL learners in a multilingual country, in order to assist with teaching and learning in the classroom.

2. Method

Ethical clearance was obtained from the Research Ethics Committee of the Faculty of Humanities at the University of Pretoria (reference number: HUM006/0320), prior to data collection. The schools and parents/guardians were informed of the study aims and provided their consent for the learners to participate. Furthermore, the learners provided assent before data collection procedures commenced.

2.1. Research design and participants

Using a quantitative, descriptive, comparative cross-sectional research design, 40 participants (7-8 years old) with the same socio-economic status (SES) were purposively selected from three English private schools in the City of Tshwane, South Africa. Participants were assigned either to the research group (ESL learners; n = 20; mean age 7.70 years ± 0.47) or the control group (EFL learners; n = 20; mean age 7.35 years ± 0.49) based on their first language (their mother tongue). A first language is identified as the language to which a person had been exposed since birth and which was learned within the critical period of language development (Saniei, 2011). If the participant's first language was English (i.e., English was spoken at home), he/she was classified as an EFL participant. If the participant's first language was a language other than English, the participant was categorized in the ESL participant group. There was no statistically significant difference between the mean age of participants from the EFL group and the mean age of participants from the ESL group. None of the participants had any known neurological or cognitive disorder, as determined by a question included in the case history questionnaire that was completed by the parents/guardians of all participants. All participants met the inclusion criteria of normal hearing (bilateral PTA ≤20 dB HL across 1 – 4 kHz) (Swanepoel et al., 2014), and normal outer and middle ear function (type A tympanograms and at least one present acoustic reflex at 1 kHz) (Hind et al., 2011; Katz, 2014). Two auditory processing tests were conducted in order to determine the selective auditory attention abilities and speech-in-noise perception of each participant.

2.2. Instrumentation and procedures

The Selective Auditory Attention Test (SAAT) and the Digits-In-Noise (DIN) test were performed during one individual sitting. The order in which these tests were administered was alternated in order to avoid order effects. A break was taken between testing if necessary. The research group (ESL learners) and the control group (EFL learners) were assessed in the same manner, time frame, and setting.

2.2.1. Selective Auditory Attention Test (SAAT)

The SAAT is a monaural low-redundancy speech test that was developed as a speech-in-competing-message test for the early identification of learners who may have a problem attending to auditory stimuli, especially in the presence of background noise (Auditec, 2015). Cherry and Rubinstein (2006) established that binaural presentation when using the SAAT resulted in better performance due to the binaural advantage when listening to stimuli binaurally. Therefore, during data collection in the current study, the SAAT was also presented binaurally. The SAAT is a closed-set picture-pointing task, consisting of two parts: two lists of Word Intelligibility by Picture Identification (WIPI) words in quiet (lists one and three), and

two lists of WIPI words presented in a competing noise (lists two and four). The competing noise comprised a speaker telling a story that was identified by children to be interesting, thus causing a semantic distraction. The WIPI words and competing story were recorded at a signal-to-competition ratio of 0 dB, which increased the test's difficulty (Auditec, 2015). Each of the four lists consists of 25 monosyllabic words (Cherry & Rubinstein, 2006). The SAAT was conducted in a quiet setting through headphones at a comfortable listening level. The comfortable listening level was held constant at approximately 50 dB HL (Aarabi et al., 2016; Rahman et al., 2011). Participants were requested to indicate the corresponding picture on the page by pointing to it as the word was heard over the headphones. During testing the researcher counted the words that were correctly identified. Four percent was given for each word correctly identified, and a percentage of correct scores was computed for each of the four lists. A score of less than 88% on the wordlists read in quiet invalidated the entire test and therefore precluded administration of the word lists imbedded in a semantic distractor.

2.2.2. Digits-In-Noise (DIN) test

Speech recognition in noise is assessed through the DIN test (De Sousa et al., 2019; Potgieter et al., 2016; Smits et al., 2013). The DIN was presented binaurally using diotic (digits and masking noise presented interaurally in phase) and antiphasic (digit stimuli presented 180-degree phase inverted to the masking noise) stimulus presentations on a smartphone with headphones in a quiet setting (De Sousa et al., 2019; Potgieter et al., 2016). Recent studies concluded that antiphasic stimulus presentations improves the ability to detect speech in the presence of a diotic masker (De Sousa et al., 2019; Wolmarans et al., 2021). The difference in signal-to-noise ratio (SNR) between diotic and antiphasic stimulus presentations is known as the binaural intelligibility level difference (BILD). As early as 1948, this phenomenon was described as the ability to spatially segregate speech from noise and understand speech in the presence of background noise (Hirsh, 1948; Licklider, 1948).

During data collection for the DIN test, participants were requested to complete the test in diotic and antiphasic listening conditions. The first digit-triplet was presented at an intensity that was based on the participant's selected comfortable listening level. After the response was entered on the keypad, the following digit-triplet was presented automatically at a 2 dB higher SNR for an incorrect response, or at a 2 dB lower SNR for a correct response. A digit-triplet was only judged as correct when all three digits were entered correctly (Potgieter et al., 2016). The Speech Reception Threshold (SRT) was calculated as the average SNR of the last 19 of 23 triplets presented in total (De Sousa et al., 2019; Potgieter et al., 2016). Since the SNR is a measure of signal strength relative to background noise, the ratio is usually measured in decibels using a SNR formula which is expressed in a logarithmic scale. A 0 dB SNR indicates that the power of the signal (speech) is equal to the noise power. When the signal power is poorer than the power of the noise, it will result in a negative SNR in dB. Thus, more negative dB SNRs where a listener can identify 50% of the digits correctly, indicate better SRTs, as well as better performance (De Sousa et al., 2019; Potgieter et al., 2016). Results for both diotic and antiphasic listening conditions were then recorded and the BILD was determined.

2.3. Data analysis

Raw data were edited, coded and categorized in a Microsoft Excel spreadsheet. Data analysis was done by means of the software G*Power version 3.1.9.4. (Faul et al., 2007) for the power analysis, and Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corporation, 2019) for all other statistical analyses. Descriptive statistics included the mean, standard deviation (SD), median and inter-quartile range (IQR) for the SAAT and DIN for the two groups. The Mann-Whitney test was used to determine the overall outcome of the continuous data of the SAAT and DIN between the two groups.

3. Results

Firstly, the comparison between the EFL and ESL groups regarding the age of exposure to English is provided. Where the median age of exposure is indicated as 0,00, the learners were for the most part exposed to English through this source from birth. The results of the SAAT are followed by the DIN test's results. Nominal results of both tests are provided subsequently.

3.1. Comparison between EFL and ESL learners regarding the age of exposure to English

Table 1

Age of exposure to English

Age of exposure to English *(in years)* through various sources	**EFL**		**ESL**		**Mann-Whitney**	**p-value**
	Mean (SD)	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**		
Via caregivers	0,00 (0,00)	0,00 (0,00)	1,30 (1,04)	1,00 (1,63)	6,000	<0,001*
Via family and friends	0,50 (1,40)	0,00 (0,00)	1,93 (1,00)	2,00 (1,25)	27,500	0,001*
Via books	1,41 (1,92)	0,50 (2,50)	3,30 (2,20)	3,50 (3,75)	64,000	0,014*
Via television	1,39 (1,26)	1,25 (3,00)	1,70 (0,97)	2,00 (1,00)	135,000	0,383
Via radio	1,42 (2,31)	0,00 (2,50)	2,30 (1,54)	2,00 (2,50)	29,000	0,068
Via nursery/day care	2,01 (1,71)	2,00 (3,13)	2,56 (1,04)	2,50 (1,25)	114,000	0,190
Via Grade R	5,78 (0,44)	6,00 (0,50)	5,73 (0,46)	6,00 (1,00)	64,500	0,812
Mean age exposed to English through all sources	1,81 (1,53)	1,86 (2,94)	2,82 (0,89)	2,67 (1,30)	94,000	0,019*

* $p \leq 0.05$

The mean age of exposure did not differ statistically significantly between the EFL and the ESL groups for exposure via television (p=0,383), radio (p=0,068), nursery/day care (p=0,190) and Grade R (p=0,812). However, statistically significant differences were found between the EFL and the ESL group for exposure via caregivers (p<0.001), family and friends (p=0,001) and books (p=0,014). In addition, the mean age of exposure was computed (by averaging all the measures of exposure) and the difference between the EFL and ESL groups was also found to be statistically significant (p=0,019). In all cases where statistically significant differences

were found, the mean age of exposure to English for ESL was significantly higher than the mean age of exposure to English for EFL.

3.2. Selective Auditory Attention Test (SAAT)

The Mann-Whitney test was used to determine whether any significant differences were present in the SAAT results between the lists presented in quiet (lists 1 and 3) and the lists presented in the presence of a competing stimulus (lists 2 and 4) (Table 2). The descriptive statistics for the lists used in the SAAT are presented with the results for lists 1 and 3 averaged, and for lists 2 and 4 averaged.

Table 2

Averaged results for lists 1 and 3 & lists 2 and 4

	EFL		**ESL**		**Mann-Whitney**	**p-value**
SAAT	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**		
Average of lists 1 & 3 – no competing stimulus (%)	96,30 (3,26)	97,00 (4,00)	96,60 (3,05)	98,00 (4,00)	188,500	0,758
Average of lists 2 & 4 – competing stimulus (%)	67,80 (8,03)	68,00 (10,00)	63,10 (7,44)	64,00 (12,00)	128,500	0,052

*p≤0.05

The mean and standard deviation of the EFL (mean = 96,30; SD = 3,26) and ESL (mean = 96,60; SD = 3,05) groups for lists 1 and 3 were similar. For lists 2 and 4, the mean and standard deviation for the EFL group (mean = 67,80; SD = 8,03) were higher than for the ESL group (mean = 63,10; SD = 7,44). However, no statistically significant differences were found between the EFL and ESL groups. It is important to note, though, that the p-value of 0,052 for the average of lists 2 and 4 is very close to 0,05.

3.3. Digits-In-Noise (DIN) test

The results of Mann-Whitney test as performed for the DIN are presented in Table 3.

Table 3

DIN hearing test results – diotic & antiphasic listening conditions

	EFL		**ESL**		**Mann-Whitney**	**p-value**
DIN	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Median (IQR)**		
Diotic (SNR)	-8,79 (0,95)	-8,90 (1,35)	-8,94 (0,98)	-8,90 (1,60)	184,000	0,664

Antiphasic (SNR)	-16,01 (1,71)	-15,90 (1,55)	-15,90 (1,42)	-15,90 (2,30)	193,500	0,860
BILD (SNR)	-7,22 (2,16)	-7,30 (3,95)	-6,96 (1,68)	-6,70 (3,00)	180,000	0,597

*p≤0.05

The SNR obtained in the diotic listening condition by the EFL group (mean = -8,79 dB) was higher than the SNR obtained in the diotic listening condition by the ESL group (mean = -8,94 dB). For the antiphasic listening condition the SNR obtained by the EFL group (mean = -16,01 dB) was lower than the SNR obtained by the ESL group (mean = -15,90 dB). However, no statistically significant difference was found between the EFL group and the ESL group for either the diotic (p=0,664) or the antiphasic (p=0,860) listening condition. The BILD calculated for the EFL group (mean = -7,22) was lower than the BILD calculated for the ESL group (mean = -6,96). No statistically significant difference was found between the EFL group and the ESL group for the BILD (p=0,597).

3.4. Integration and correlation of results

In order to determine the strength of association between the SAAT and DIN, the Spearman rank correlation was used. For the purpose of discussion, the researcher will only focus on the correlations established between the averaged results of lists 1 and 3 and lists 2 and 4 of the SAAT (due to small sample size) and the diotic and antiphasic listening conditions of the DIN (Table 4).

Table 4

Strength of association between the SAAT and DIN

Tests		**Values**	**SAAT: List 1 & 3 (non-competing)**	**SAAT: List 2 & 4 (competing)**	**DIN: diotic (SNR)**	**DIN: antiphasic (SNR)**
Control (EFL) Group	**SAAT: List 1 & 3 (non-competing)**	**r_s**	1,000	0,115	-0,120	-0,158
		p-value		0,629	0,613	0,507
	SAAT: List 2 & 4 (competing)	**r_s**	0,115	1,000	0,224	-0,208
		p-value	0,629		0,342	0,378
	DIN: in-phase	**r_s**	-0.120	0,224	1,000	-0,272
		p-value	0,613	0,342		0,246
	DIN: out-of-phase	**r_s**	-0,158	-0,208	-0,272	1,000
		p-value	0,507	0,378	0,246	
Research (ESL) group	**SAAT: List 1 & 3 (non-competing)**	**r_s**	1,000	-0,167	-0,623*	0,349
		p-value		0,482	0,003	0,132
		r_s	-0,167	1,000	-0,014	0,058

	SAAT: List 2 & 4 (competing)	**p-value**	0,482		0,953	0,809
	DIN: in-phase	**r_s**	-0,623*	-0,014	1,000	-0,026
		p-value	0,003	0,953		0,912
	DIN: out-of-phase	**r_s**	0,349	0,058	-0,026	1,000
		p-value	0,132	0,809	0,912	

*p≤0.05

A statistically significant negative correlation (r_s= -0.623) was established within the ESL group between the DIN in the diotic listening condition and the average of SAAT lists 1 and 3 in the non-competing listening condition (p=0.003). This means that as the value of the average of lists 1 and 3 of the SAAT increased, the value of the DIN: diotic SNR decreased. As stated earlier regarding the DIN, more negative SNRs indicate better test performance (Potgieter et al., 2016). Therefore, as the value of the SAAT lists 1 and 3 increased, the results for the DIN: diotic listening condition will also be identified as better performance. For the EFL group, no statistically significant correlations were found between the tests.

4. Discussion and conclusion

4.1. Summary of results and contributions of the study

In order to achieve academic success when the LoLT is an additional language rather than the first language, learners need to master various auditory processing skills including selective auditory attention and speech-in-noise perception (Anderssen et al., 2019; Shield & Dockrell, 2008).

4.1.1. The comparison between EFL and ESL learners regarding the age of exposure to English

The findings seem to indicate that selective auditory attention and speech-in-noise perception were not adversely affected in the ESL learners who participated in this study. These findings are not in agreement with those of previous studies investigating either selective auditory attention (Venter, 2019) or speech-in-noise perception (Bovo et al., 2018; Florentine, 1985; Nelson et al., 2005; Tabri et al., 2011) in ESL speakers. These studies found that proficiency (or lack of proficiency) in the LoLT plays an influential role in selective auditory attention and speech-in-noise perception in ESL learners.

Due to the mediating role of language proficiency and selective auditory attention, second language learners are negatively influenced to a greater extent than first language learners by noise in speech perception tasks (Klatte et al., 2013). Bovo et al. (2018) and Florentine (1985) determined that speech-in-noise perception in ESL speakers correlates significantly with years of exposure to the second language. Speech perception in noise was found to improve as the period of exposure to the second language increased. Therefore, earlier exposure to the second language is associated with improved understanding of speech in noise from an early age (Kousaie et al., 2019).

Age of exposure to an additional language is influenced by several external factors, such as choice of schools (privately or government funded), geographic location (i.e. urban, suburban, rural) and SES (Alejo & Piquer-Pìriz, 2016; Hossain, 2016). Three private schools were included in this study, and it is possible that the parents of these learners are from a different educational and socio-cultural background than parents of ESL learners located in rural areas, from lower SES households and in government funded schools (Hoff, 2006). The discrepancy between the current and previous studies may be due to the participants' more favourable exposure to English at an early age when compared to ESL learners located in rural areas and from lower SES households, with majority who have minimal English exposure when they reach school age. Regarding the statistically significant differences found between the mean age of first exposure to English through caregivers, as well as family and friends, it is important to keep in mind that the mean age of exposure of the ESL learners (mean age = 1.30 years ±1.04) is still lower than that of the majority ESL learners located in rural areas and from lower socio-economic backgrounds whose first exposure to English is generally only when they reach school age (Alejo & Piquer-Pìriz, 2016).

Previous research investigated various factors that contribute to the difference of performance in English between learners located in rural and urban areas (Hossain, 2016). Hossain (2016) found that factors such as parental education status, SES, and the availability of adequate books to read definitely contribute to the poor proficiency in English of ESL learners located in rural areas. On average, young children from lower SES households where a language other than English is spoken, have language trajectories that are different from those of children from middle or high SES, bilingual households (Hoff, 2013). Al-Zoubi (2018), recommended that ESL learners should be frequently exposed to English through various sources, including by watching English programmes on television, surfing the internet, listening to the radio, reading English books, and communicate with EFL speakers on a daily basis in order to improve their proficiency in English (Al-Zoubi, 2018). In 2019 it was determined that South Africa has very high child poverty rates, where 76% of children between 0-17 years of age are living below the poverty line, are from lower socio-economic backgrounds located in rural areas and do not have access to sufficient educational resources (Hall, 2021; Hoff, 2013). In the current study, the ESL learners were exposed to English through reading English books at approximately three years of age, (mean age = 3.30 years ± 2.20) which might be an earlier age than the majority of South African learners who have limited access to educational resources, such as books (Alejo & Piquer-Pìriz, 2016). These learners who have access to more facilities (i.e. nursery/day care, grade R) or resources (i.e. television, radio) are identified as having an advantage when compared to those from lower SES households (Hoff, 2013; Hossain, 2016). This can be substantiated by the insignificant differences established within the current study between the two participant groups for age of exposure to English through television, radio, nursery/day care and through Grade R. Therefore, it is recommended that this study be replicated in a rural area and include learners from government funded schools and from various socio-economic backgrounds, as the current findings are based on learners in private schools located in an urban area and thus from higher SES households and learners in rural areas might present with lower English proficiency when compared to learners in urban areas. This discrepancy relates to their ideal access to educational resources.

4.1.2. Selective Auditory Attention Test (SAAT)

In the non-competing and ideal conditions (lists 1 and 3), the EFL and ESL groups achieved similar results. In the conditions where a semantic distractor was present (lists 2 and 4), there is a definite trend for the EFL group to perform slightly better. Although not statistically significant, the calculated probability (p-value) of 0,052 established for the average of lists 2 and 4, which is extremely close to 0,05, may be indicative that if a larger sample size was included in the study, a statistically significant difference might have been present for the lists presented in the presence of a competing story. Thus, a recommendation for future research is to replicate this study, but with a larger sample size to investigate this probability further and shed more light on this finding.

These results do not correlate, however, with findings from previous research regarding selective auditory attention abilities in ESL learners. Venter (2019), determined that ESL learners have greater difficulty attending to the target stimuli whilst suppressing the competing noise to understand speech (Venter, 2019). Warzybok et al. (2015) also found significant differences between first and second language speakers on tasks which require selective attention to speech as the listening conditions became more demanding (Warzybok et al., 2015). It is important to note that should a larger sample size be included in the current study, a statistically significant difference might be present and the results would then correlate with findings from previous research.

4.1.3. Digits-in-Noise (DIN) test

The EFL group did not perform significantly better than the ESL group in either the diotic or the antiphasic listening conditions. The results within the diotic listening condition agree with previous research that established no significant effects on ESL speakers' ability to recognise digit-triplets in noise presented interaurally in-phase (Anderssen et al., 2019; Kaandorp et al., 2015). The results obtained within the antiphasic listening condition are in agreement with the findings of De Sousa et al. (2019) and Wolmarans et al. (2021), who established that when evaluating SRT the use of the antiphasic listening condition was shown to improve the DIN SRTs in normal hearing listeners (De Sousa et al., 2019), and also in normal hearing children from seven years of age (Wolmarans et al., 2021). The insignificant difference in the BILD established between the two participant groups and derived from the diotic and antiphasic results, substantiates the finding that the ESL learners who participated in the current study do not appear to be at a distinct disadvantage both to spatially segregate speech from noise and to understand speech in the presence of background noise.

Despite the fact that the DIN test is a well-known and often used speech-in-noise test, the results of the current study do not correlate with previous research on speech-in-noise perception in second language speakers. Several studies have found that bilingual speakers perform worse in their second language in terms of perceiving speech in noise (Lucks Mendel & Widner, 2016; Mayo et al., 1997; Shi, 2010; Tabri et al., 2011). Some studies have suggested that an early age of exposure to and acquisition of an additional language could mediate speech-in-noise processing in the second language, with earlier exposure and acquisition being associated with performance similar to first language speakers (Bovo et al., 2018; Reetzke et al., 2016; Tabri et al., 2011). Another study also suggested that children's abilities to recognise speech in noise develop well with age into adolescence (Wolmarans et al., 2021). Although there is a statistically significant difference between the EFL and ESL groups for the mean age

of exposure to English, it is important to keep in mind that the current study has a small sample size, and also that the participants included in the study are from higher socio-economic backgrounds than most of the learners in South Africa and most probably exposed to English from an earlier age than learners from lower socio-economic backgrounds located in rural areas.

4.1.4. Correlations between the SAAT and DIN

The negative correlation established between the ESL learners' test results for the non-competing lists in the SAAT and the diotic listening condition for the DIN might be due to the varying linguistic demands of the stimuli used in the respective tests. The choice of speech material used when testing auditory processing skills can have a significant influence (Anderssen et al., 2019).

For the DIN test, it was essential to use easy, familiar words within a closed-set paradigm instead of open-set sentences or words in order to decrease the impact of linguistic skills on the test outcome (Smits et al., 2013). Digits have been identified as one category of highly familiar words. They are in the lists of commonly spoken words and therefore are not known to be linguistically demanding, since numbers are some of the first words a child learns when acquiring a second language (Smits et al., 2013). The WIPI words imbedded in the lists used when completing the SAAT are simple monosyllabic words which result in decreased linguistic demand of the test. Keep in mind that participants are also provided with pictures to choose from. The use of pictures adds a visual component that can aid the listener, especially given that the test is a four-alternative forced-choice (4AFC) closed set task (Cherry & Rubinstein, 2006).

Regarding the negative correlation between the ESL learners' results for the SAAT and DIN, it is important to remember that more negative DIN results refer to better test performance. Therefore, as the participants performed better in the SAAT lists 1 and 3, their performances in the DIN: diotic listening condition also improved. These results correlate with research that previously determined a relationship between improved speech-in-noise perception abilities and the development of auditory processing efficiency with age, such as selective attentional control (Bovo et al., 2018; Elliot, 1979; Johnson, 2000; Moore, 2015). However, with regard to attention, the results of the current study do not support the findings of Klatte et al. (2013), who determined that the immature selective auditory attention abilities of children add to their struggle with speech perception in noise (Klatte et al., 2013).

4.2. Conclusion

The finding that the differences between the EFL and ESL groups for the SAAT and DIN are statistically insignificant can most likely be ascribed to the fact that ESL learners in private schools and from higher SES households are exposed to English at an earlier age than ESL learners from lower SES households located in rural areas. Another reason might be the small sample size included in this study. There is a need for additional research with a larger sample size to determine the selective auditory attention abilities and speech-in-noise perception skills of ESL learners in government funded schools located in rural areas and from various socio-economic backgrounds.

Conflict of interest statement

None declared.

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References

Aarabi, S., Jarollahi, F., & Jalaei, S. (2016). Development and determination of the validity of Persian version of monaural selective auditory attention test in learning disabled children. *Auditory and Vestibular Research Journal*, *25*(1), 49–54.

Al-Zoubi, S. M. (2018). The impact of exposure to English language on language acquisition. *Journal of Applied Linguistics and Language Research*, *5*(4), 151–162.

Alain, C., Reinke, K., He, Y., Wang, C., & Lobaugh, N. (2005). Hearing two things at once: Neurophysiological indices of speech segregation and identification. *Journal of Cognitive Neuroscience*, *17*(5), 811–818. https://doi.org/10.1162/0898929053747621

Alejo, R., & Piquer-Pìriz, A. (2016). Urban vs. rural CLIL: An analysis of input-related variables, motivation and language attainment. *Language, Culture and Curriculum*, 1–18. https://dx.doi.org/10.1080/07908318.2016.1154068

American National Standards Institute. (2002). Acoustic performance criteria, design requirements and guidelines for schools. *ANSI S12.60*.

American Speech-Language-Hearing Association. (2005). (Central) auditory processing disorders: The role of the audiologist. *American Speech-Language-Hearing Association*. https://www.asha.org/content.aspx?id=10737450473

Anderssen, K.-L., Kritzinger, A., & Pottas, L. (2019). Auditory skills and listening comprehension in English second language learners in Grade 1. *South African Journal of Childhood Education*, *9*(1), a600. https://doi.org/10.4102/sajce.v9i1.600

Auditec. (2015). *Selective Auditory Attention Test (SAAT)*. Auditec, Inc. https://auditec.com/2015/08/04/selective-auditory-attention-test-saat/

Baker, C. (2006). Chapter 8: Cognitive theories of bilingualism and the curriculum. In *Foundations of bilingual education and bilingualism* (pp. 166–186).

Bellis, T. J. (2004). Understanding auditory processing disorders in children. *American Speech-Language-Hearing Association*, 5167–5769.

Bellis, T. J. (2011). Chapter 2: Mechanisms of Selected Auditory and Related Processes. In T. J. Bellis (Ed.), *Assessment and Management of Central Auditory Processing Disorders in the Educational Setting: From Science to Practice* (Second, pp. 51–83). Plural Publishing Inc.

Blaikie, N., & Priest, J. (2019). *Designing social research: The logic of anticipation* (3rd ed.). John Wiley & Sons.

Bovo, R., Lovo, E., Astolfi, L., Montino, S., Franchella, S., Gallo, S., Prodi, N., Borsetto, D., & Trevisi, P. (2018). Speech perception in noise by young sequential bilingual children. *ACTA Othorhinolaryngologica Italica*, *38*, 536–543. https://doi.org/10.0.57.47/0392-100X-1846

British Society of Audiology. (2007). *Auditory Processing Disorder*. British Society of Audiology Steering Group. https://www.thebsa.org.uk/apd/Home

Brock-Utne, B., & Skattum, I. (2009). *Languages and education in Africa: A comprehensive and transdisciplinary analysis*. Symposium Books.

Bronkhorst, A. W. (2000). The cocktail party phenomenon: A review of research on speech intelligibility in multiple-talker conditions. *Acta Acustica United with Acustica*, *86*(1), 117–128.

Chang, A. C., Wu, B. W., & Pang, J. C. (2013). Second language listening difficulties perceived by low-level learners. *Perceptual and Motor Skills*, *116*(2), 415–434. doi: 10.2466/22.23.PMS.116.2.415-434%0A

Chermak, G. D., Hall, J., & Musiek, F. (1999). Differential diagnosis and management of central auditory processing disorder and attention deficit hyperactivity disorder. *Journal of American Academy of Audiology*, *6*, 289–303.

Chermak, G. D., & Montgomery, M. J. (1992). Form equivalence of the Selective Auditory Attention Test administered to 6-year-old children. *Journal of Speech, Language and Hearing Research*, *35*(3), 661–665. https://doi.org/10.1044/jshr.3503.661

Cherry, R. (1980). *Selective Auditory Attention Test*. Auditec.

Cherry, R., & Rubinstein, A. (2006). Comparing monotic and diotic selective auditory attention abilities in children. *Language, Speech, and Hearing Services in Schools*, *37*(2), 137–142. doi: 10.1044/0161-1461(2006/015)

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (Second). Lawrence Erlbaum Associates, Publishers.

Cole, E., & Flexer, C. (2015). *Children with hearing loss: Developing listening and talking, birth to six*. Plural Publishing.

Collier, V. P. (1987a). Age and rate of acquisition of second language for academic purposes. *TESOL Quarterly*, *21*, 617–641.

Collier, V. P. (1987b). The effect of age on acquisition of a second language for school. *New Focus, NCBE Occasional Papers in Bilingual Education Number 2*.

Collier, V. P., & Thomas, W. P. (1988). Acquisition of cognitive-academic second language proficiency: A six year study. *Paper Presented at the Annual Meeting of the American Educational Research Association*.

Constitution of the Republic of South Africa. (1996). *Constitution of the Republic of South Africa [South Africa]*. [South Africa]. https://www.refworld.org/docid/3ae6b5de4.html

Cummins, J. (2008). BICS and CALP: Empirical and theoretical status of the distinction. In N. H. Hornberger (Ed.), *Encyclopedia of Language and Education* (pp. 487–499). Springer.

Dawes, P., Bishop, D. V., Sirimanna, T., & Bamiou, D. E. (2008). Profile and aetiology of

children diagnosed with auditory processing disorder (APD). *International Journal of Pediatric Othorhinolaryngology*, *72*(4), 483–489. doi: 10.1016/j.ijporl.2007.12.007

De Sousa, K. C., Swanepoel, D. W., Moore, D. R., Myburgh, H. C., & Smits, C. (2019). Improving sensitivity of the digits-in-noise test using antiphasic stimuli. *Ear and Hearing*, 1–9. doi: 10.1097/AUD.0000000000000775

Department of Health. (2015). *Ethics in health research: Principles, processes and structures (2nd ed.)*. South Africa: Department of Health. ru.ac.za/media/rhodesuniversity/content/ethics/documents/nationalguidelines/DOH_(2015)_Ethics_in_health_research_Principles,_processes_and_structures.pdf

Dockrell, J. E., & Shield, B. M. (2006). Acoustical barriers in classrooms: The impact of noise on performance in the classroom. *British Educational Research Journal*, *32*(3), 509–525. doi: 10.1080/01411920600635494

Draucker, C. B., Martsolf, D. S., & Poole, C. (2009). Developing distress protocols for research on sensitive topics. *Archives of Psychiatric Nursing*, *23*(5), 343–350. doi: 10.1016/j.apnu.2008.10.008

Elliot, L. L. (1979). Performance of children aged 9 to 17 years on a test of speech intelligibility in noise using sentence material with controlled word predictability. *The Journal of the Acoustical Society of America*, *66*, 651–653.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175–191. https://doi.org/10.3758/BF03193146

Ferre, J. (2006). Management strategies for APD. In T. Parthasarathy (Ed.), *An Introduction to Auditory Processing Disorders in Children* (pp. 161–183). Lawrence Erlbaum Associates.

Field, A. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). SAGE.

Flexer, C. (2004). The impact of classroom acoustics: Listening, learning and literacy. *Seminars in Hearing*, *25*(2), 131–140. doi: 10.1055/s-2004-828664

Florentine, M. (1985). Speech perception in noise by fluent, nonnative listeners. *Proceedings of the Acoustical Society of Japan*, H-85-16.

Hall, K. (2021). *Child poverty*. Statistics on Children in South Africa. http://childrencount.uct.ac.za/indicator.php?domain=2&indicator=98

Hay, I., & Fielding-Barnsley, R. (2012). Social learning, language and literacy. *Australian Journal of Early Childhood*, *37*(1), 24–29. https://doi.org/10.1177/183693911203700104

Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. *Evidence-Based Nursing*, *18*, 66–67. http://dx.doi.org/10.1136/eb-2015-102129

Henning, E. (2012). Learning concepts, language, and literacy in hybrid linguistic codes: The multilingual maze of urban grade 1 classrooms in South Africa. *Perspectives in Education*, *30*(3), 69–77.

Heugh, K. (2009). Into the cauldron: An interplay of indigenous and globalised knowledge with strong and weak notions of literacy and language education in Ethiopia and South

Africa. *Language Matters*, *40*, 166–189. https://doi.org/10.1080/10228190903188559

Hind, S. E., Haines-Bazrafshan, R., Benton, C. L., Brassington, W., Towle, B., & Moore, D. R. (2011). Prevalence of clinical referrals having hearing thresholds within normal limits. *International Journal of Audiology*, *50*(10), 708–716. doi: 10.3109/14992027.2011.582049

Hirsh, I. J. (1948). The influence of interaural phase on interaural summation and inhibition. *J Acoust Soc Audiol Am*, *20*, 536–544. https://doi.org/10.1121/1.1906407

Hoff, E. (2006). How social contexts support and shape language development. *Developmental Review*, *26*(1), 55–88. https://doi.org/10.1016/j.dr.2005.11.002

Hoff, E. (2013). Interpreting the early language trajectories of children from low SES and language minority homes: Implications for closing achievement gaps. *Developmental Psychology*, *49*(1), 4–14. https://doi.org/10.1037/a0027238

Holt, L. L., & Lotto, A. J. (2010). Speech perception as categorization. *Attention, Perception and Psychophysics*, *72*(5), 1218–1227. doi: 10.3758/APP.72.5.1218

Hossain, M. M. (2016). English language teaching in rural areas: A scenario and problems and prospects in context of Bangladesh. *Advances in Language and Literacy Studies*, *7*(3), 1–12.

IBM Corporation. (2019). *IBM SPSS Statistics for Windows* (26.0). NY: IBM Corp. https://www.ibm.com/products/spss-statistics

Isbell, E., Wray, A. H., & Neville, H. J. (2016). Individual differences in neural mechanisms of selective auditory attention in preschoolers from lower socioeconomic status backgrounds: An event-related potentials study. *Developmental Science*, *19*(6), 865–880. doi: 10.1111/desc.12334

Jansen, S., Luts, H., Wagener, K. C., Franchet, B., & Wouters, J. (2010). The French digit triplet test: A hearing screening tool for speech intelligibility in noise. *International Journal of Audiology*, *49*(5), 378–387. doi: 10.3109/14992020903431272

Johnson, C. E. (2000). Children's phoneme identification in reverberation and noise. *The Journal of Speech, Language, and Hearing Research*, *43*, 144–157.

Kaandorp, M., De Groot, A., Festen, J., Smits, C., & Goverts, S. (2015). The influence of lexical-access ability and vocabulary knowledge on measure of speech recognition in noise. *International Journal of Audiology*, *55*, 157167. http://dx.doi.org/10.3109/14992027.2015.1104735

Kapp, R. (2004). Reading on the line: An analysis of literacy practices in ESL classes in a South African township school. *Journal of Language and Education*, *18*(1), 246–263.

Katz, J. (2014). *Handbook of clinical audiology* (7th ed.). Wolters Kluwer Health.

Kendall, M. (2003). Designing a research project: Randomised controlled trials and their principles. *Emergency Medicine Journal*, *20*, 164–168.

Khavarghazalani, B., Farahani, F., Emadi, M., & Dastgerdi, Z. H. (2016). Auditory processing abilities in children with chronic otitis media with effusion. *Acta Oto-Laryngologica*, *136*(5), 456–459. https://doi.org/10.3109/00016489.2015.1129552

Kidd, G., Mason, C. R., Best, V., & Marrone, N. (2010). Stimulus factors influencing spatial

release from speech-on-speech masking. *The Journal of the Acoustical Society of America*, *128*(4), 1965–1978. doi: 10.1121/1.3478781

Klatte, M., Bergström, K., & Lachmann, T. (2013). Does noise affect learning? A short review on noise effects on cognitive performance in children. *Frontiers in Psychology*, *4*, 1–6. https://doi.org/10.3389/fpsyg.2013.00578

Kollmeier, B., Warzybok, A., Hochmuth, S., Zokoll, M. A., Uslar, V., Brand, T., & Wagener, K. C. (2015). The multilingual matrix test: Principles, applications and comparisons across languages: A review. *International Journal of Audiology*, *54*(2), 3–16. doi: 10.3109/14992027.2015.1020971

Koopsman, W. J. A., Goverts, S. T., & Smits, C. (2018). Speech recognition abilities in normal-hearing children 4 to 12 years of age in stationary and interrupted noise. *Ear and Hearing*, *39*(6), 1091–1103. doi: 10.1097/AUD.0000000000000569

Kotzé, E., & Hibbert, L. (2010). Are multilingual education policies pipe dreams? *Interdisciplinary Journal for the Study of the Arts and Humanities in Southern Africa*, *17*(1), 4–25.

Kousaie, S., Baum, S., Phillips, N. A., Gracco, V., Titone, D., Chen, J. K., Chai, X. J., & Klein, D. (2019). Language learning experience and mastering the challenges of perceiving speech in noise. *Brain and Language*, *196*, 1–9. https://doi.org/10.1016/j.bandl.2019.104645

Landsberg, E., Kruger, D., & Swart, E. (2016). *Addressing barriers to learning: A South African perspective* (3rd ed.). Van Schaik.

Lanzetta-Valdo, B. P., De Oliveira, G. A., Ferreira, J. T. C., & Palacios, E. M. N. (2017). Auditory processing assessment in children with Attention Deficit Hyperactivity Disorder: An open study examining methylphenidate effects. *International Archives of Otorhinolaryngology*, *21*(1), 72–78. doi: 10.1055/s-0036-1572526

Leedy, P. D., & Ormrod, J. E. (2005). *Practical research: Planning and design* (8th ed.). Pearson.

Leedy, P. D., & Ormrod, J. E. (2013). *Practical research: Planning and design* (10th ed.). Pearson.

Lewis, M. P. (2009). *Table 1: Distribution of languages by area of origin*. Ethnologue, SIL International.

Licklider, J. C. R. (1948). The influence of interaural phase relations upon the masking of speech by white noise. *The Journal of the Acoustical Society of America*, *20*(2), 150–159. https://doi.org/10.1121/1.1906358

Lucks Mendel, L., & Widner, H. (2016). Speech perception in noise for bilingual listeners with normal hearing. *International Journal of Audiology*, *55*(2), 126–134.

Margolis, R. H., Wilson, R. H., Popelka, G. R., Eikelboom, R. H., Swanepoel, D. W., & Saly, G. L. (2015). Distribution characteristics of normal pure-tone thresholds. *International Journal of Audiology*, *54*(11), 796–205. doi: 10.3109/14992027.2015.1033656

Maxwell, D. L., & Satake, E. (2006). *Research and statistical methods in communication sciences and disorders*. Thomson/Delmar Learning.

Mayo, L. H., Florentine, M., & Buus, S. (1997). Age of second-language acquisition and perception of speech in noise. *Journal of Speech, Language and Hearing Research*, *40*(3), 686–693.

McCullagh, J., & Bamiou, D. E. (2014). Measures of binaural interaction. In F. E. Musiek & G. D. Chermak (Eds.), *Handbook of central auditory processing disorders: Auditory neuroscience and diagnosis* (pp. 435–469). Plural Publishing.

Moonsamy, S., & Kathard, H. (2015). *Speech-language therapy in a school context - Principles and practices*. Van Schaik.

Moore, D. R. (2007). Auditory processing disorders: Acquisition and treatment. *Journal of Communication Disorders*, *40*(4), 295–304. https://doi.org/10.1016/j.jcomdis.2007.03.005

Moore, D. R. (2015). Maturation and aging. In J. J. Eggermont (Ed.), *Auditory temporal processing and its disorders*. Oxford University Press.

Morrow, N., Jordaan, H., & Fridjhon, P. (2005). The effects of educational context on the understanding of linguistic concepts in English and isiZulu by Grade 7 learners. *South African Journal of Education*, *25*(3), 164–169.

Nassaji, H. (2015). Qualitative and descriptive research: Data type versus data analysis. *Language Teaching Research*, *19*(2), 129–132. https://doi.org/10.1177/1362168815572747

National Health Act No. 61, 2003, Pub. L. No. 61 (2004).

Ndimande-Hlongwa, N., & Wildsmith-Cromarty, R. (2010). Multilingualism for access, language development and language intellectualisation. *Interdisciplinary Journal for the Study of the Arts and Humanities in Southern Africa*, *17*(1), 92–105.

Nelson, P., Kohnert, K., Sabur, S., & Shaw, D. (2005). Classroom noise and children learning through a second language: Double jeopardy? *Language, Speech, and Hearing Services in Schools*, *36*(3), 219–229. https://doi.org/10.1044/0161-1461(2005/022)

Nieman, M., & Hugo, A. (2010). Using English as a second language as the language of instruction: Concerns and needs of primary school teachers in South Africa. *Journal of Language Teaching*, *44*(1), 59–69. doi: 10.4314/jlt.v44i1.71781

Owens, R. E., & Owens, R. E. (2012). *Language development: An introduction* (8th ed.). Pearson.

Pandor, N. (2006). *Address by the Minister of Education, Naledi Pandor, MP, at the language colloquium, Cape Town*. http://www.info.gov.za/speeches/2006/06080114451001.htm

Parker, R. B. (2001). A definition of privacy. In E. Barendt (Ed.), *Privacy*. Routledge.

Potgieter, J. M., Swanepoel, D. W., Myburgh, H. C., Hopper, T. C., & Smits, C. (2016). Development and validation of a smartphone-based digits-in-noise hearing test in South African English. *International Journal of Audiology*, *55*(7), 405–411. doi: 10.3109/14992027.2016.1172269

Pretorius, E. J. (2002). Reading ability and academic performance in South Africa: Are we fiddling while Rome is burning? *Language Matters - Studies in the Languages of Africa*,

33(1), 169–196. https://doi.org/10.1080/10228190208566183

Rahman, T. T. A., Mohamed, S. T., Albanouby, M. H., & Bekhet, H. F. (2011). Central auditory processing in elderly with mild cognitive impairment. *Geriatrics Gerontology International*, *11*, 304–308.

Reetzke, R., Lam, B. P., Xie, Z., Sheng, L., & Chandrasekaran, B. (2016). Effect of simultaneous bilingualism on speech intelligibility accross different masker types, modalities, and signal-to-noise ratios in school-aged children. *PLoS ONE*, *11*, *12*, 1–19. https://doi.org/10.1371/journal.pone.0168048

Richard, G. J. (2019). Language Processing versus Auditory Processing. In D. Geffner & D. Ross-Swain (Eds.), *Auditory Processing Disorders - Assessment, Managementm and Treatment* (Third, pp. 224–226). Plural Publishing Inc.

Rogers, C. L., Lister, J. J., Febo, D. M., Besing, J. M., & Abrams, H. B. (2006). Effects of bilingualism, noise, and reverberation on speech perception by listeners with normal hearing. *Applied Psycholinguistics*, *27*, 465–485. doi: 10.1017.S014271640606036X

Ross, D. S., Holstrum, W. J., Gaffney, M., Green, D., Oyler, R. F., & Gravel, J. S. (2008). Hearing screening and diagnostic evaluation of children with unilateral and mild bilateral hearing loss. *Trends in Amplification*, *12*(1), 27–34. doi: 10.1177/1084713807306241

Salkind, N. J. (2010). *Encyclopedia of research design*. SAGE Publications Ltd.

Saniei, A. (2011). Who is an ideal native speaker? *2011 International Conference on Languages, Literature and Linguistics, IPEDR*, *26*, 74–78.

Schafer, E. C., Bryant, D., Sanders, K., Baldus, N., Lewis, A., Traber, J., & Algier, K. (2013). Listening comprehension in background noise in children with normal hearing. *Journal of Educational Audiology*, *19*, 58–64.

Setia, M. S. (2016). Methodology series module 5: Sampling strategies. *Indian Journal of Dermatology*, *61*(5), 505. doi: 10.4103/0019-5154.190118

Sharma, M., Purdy, S. C., & Kelly, A. S. (2009). Comorbidity of Auditory Processing, Language, and Reading Disorders. *Journal of Speech, Language, and Hearing Research*, *52*(3), 706–722. https://doi.org/10.1044/1092-4388(2008/07-0226)

Shi, L. F. (2010). Perception of acoustically degraded sentences in bilingual listeners who differ in age of english acquisition. *Journal of Speech, Language and Hearing Research*, *53*(4), 821–835. https://doi.org/10.1044/1092-4388(2010/09-0081)

Shield, B. M., & Dockrell, J. E. (2008). The effects of environmental and classroom noise on the academic attainments of primary school children. *The Journal of the Acoustical Society of America*, *123*(1), 133–144. https://doi.org/10.1121/1.2812596

Smits, C., Goverts, S. T., & Festen, J. M. (2013). The digits-in-noise test: Assessing auditory speech recognition abilities in noise. *The Journal of the Acoustical Society of America*, *133*(3), 1693–1706. https://doi.org/10.1121/1.4789933

Smits, C., Kapteyn, T. S., & Houtgast, T. (2004). Development and validation of an automatic speech-in-noise screening test by telephone. *International Journal of Audiology*, *43*, 15–28.

South African National Department of Basic Education. (2010). *Report on the 2009/2010 annual survey for ordinary schools*. www.gov.za/sites/default/files/gcis_document/201409/report-2009-2010-annual-surveys-ordinary-schools.pdf

Spaull, N. (2016). Disentangling the language effect in South African schools: Measuring the impact of "language of assessment" in grade 3 literacy and numeracy. *South African Journal of Childhood Education*, *6*(1), 1–20. doi: 10.4102/sajce.v6i1.475

Statistics South Africa. (2012). *Census 2011: Census in brief*. Statistics South Africa. http://www.statssa.gov.za/census/census_2011/census_products/Census_2011_Census_in_brief.pdf

Stevens, C., & Bavelier, D. (2012). The role of selective attention on academic foundations: A cognitive neuroscience perspective. *Developmental Cognitive Neuroscience*, *2*(SUPPL. 1), S30–S48. https://doi.org/10.1016/j.dcn.2011.11.001

Strait, D. L., & Kraus, N. (2011). Can you hear me now? Musical training shapes functional brain networks for selective auditory attention and hearing speech in noise. *Frontiers in Psychology*, *2*(JUN), 1–10. https://doi.org/10.3389/fpsyg.2011.00113

Swanepoel, D. W., Myburgh, H. C., Howe, D. M., Mahomed, F., & Eikelboom, R. H. (2014). Smartphone hearing screening with integrated quality control and data management. *International Journal of Audiology*, *53*(12), 841–849. doi: 10.3109/14992027.2014.920965

Tabri, D., Chacra, K. M. S. A., & Pring, T. (2011). Speech perception in noise by monolingual, bilingual and trilingual listeners. *International Journal of Language and Communication Disorders*, *46*(4), 411–422. doi: 10.3109/13682822.2010.519372

Talcott, J. B., Witton, C., Hebb, G. S., Stoodley, C. J., Westwood, E. A., France, S. J., Hansen, P. C., & Stein, J. F. (2002). On the relationship between dynamic visual and auditory processing and literacy skills; results from a large primary-school study. *Dyslexia*, *8*(4), 204–225. https://doi.org/10.1002/dys.224

Taylor, S., & von Fintel, M. (2016). Estimating the impact of language of instruction in South African primary schools: A fixed effects approach. *Economics of Education Review*, *50*, 75–89. http://doi.org/10.1016/j.econedurev.2016.01.003

University of Pretoria. (2018). *Code of ethics for research*. University of Pretoria. https://www.up.ac.za/media/shared/Legacy/sitefiles/file/45/2875/code_ethics_researchrt42999.pdf

Vandergrift, L. (2004). Listening to learn or learning to listen. *Annual Review of Applied Linguistics*, *24*, 3–25. doi:10.1017/S0267190504000017

Vandergrift, L., & Goh, C. C. (2018). *Teaching English to Second Language Learners in Academic Contexts*. Routledge.

Venter, C. (2019). *Selective auditory attention and listening comprehension in English additional language learners* [MA Dissertation, University of Pretoria]. UPSpace Institutional Repository. http://hdl.handle.net/2263/72711

Warzybok, A., Brand, T., Wagener, K. C., & Kollmeier, B. (2015). How much does language proficiency by non-native listeners influence speech audiometric tests in noise? *International Journal of Audiology*, *54*(sup2), 88–99. doi:

10.3109/14992027.2015.1063715

Watson, R. (2015). Quantitative research. *Nursing Standard*, *29*(31). https://doi.org/10.7748/ns.29.31.44.e8681

Webb, V., Lafon, M., & Pare, P. (2010). Bantu languages in education in South Africa: An overview. Ongekho akekho! - The absentee owner. *South African Journal of Childhood Education*, *38*(3), 273–292. https://doi.org/10.1080/09571730903208389

Wible, B., Nicol, T., & Kraus, N. (2005). Correlation between brainstem and cortical auditory processes in normal and language-impaired children. *Brain*, *128*(2), 417–423. https://doi.org/10.1093/brain/awh367

Wildschut, Z., Moodley, T., & Aronstam, S. (2016). The baseline assessment of Grade 1 learners' literacy skills in a socio-economically disadvantaged school setting. *South African Journal of Childhood Education*, *6*(1), 1–9. https://doi.org/10.4102/sajce.v6i1.340

Wolmarans, J., De Sousa, K. C., Frisby, C., Mahomed-Asmail, F., Smits, C., Moore, D. R., & Swanepoel, D. W. (2021). Speech recognition in noise using binaural diotic and antiphasic Digits-In-Noise in children: Maturation and self-test validity. *Journal of the American Academy of Audiology*, *32*(5), 315–323.

Yilmaz, H., & Yavuz, F. (2015). The problems young learners encounter during listening skills. *Procedia - Social and Behavioral Sciences*, *197*, 2046–2050. https://doi.org/10.1016/j.sbspro.2015.07.570

Zokoll, M. A., Wagener, K. C., Brand, T., Buschermöhle, M., & Kollmeier, B. (2012). Internationally comparable screening tests for listening in noise in several European languages: The German digit triplet test as an optimization prototype. *International Journal of Audiology*, *51*(9), 697-aaaa707. https://doi.org/10.3109/14992027.2012.690078

CHAPTER 4: Conclusion and future recommendations

The aim of this chapter is to discuss the contributions and implications of the study. A critical evaluation of the strengths and limitations of the study as well as recommendations for the direction of future research are provided.

4.1. Summary of research results

In order to achieve academic success when the LoLT is an additional language rather than the first language, learners need to master various auditory processing skills including selective auditory attention and speech-in-noise perception (Anderssen et al., 2019; Shield & Dockrell, 2008). This study aimed to investigate the selective auditory attention abilities and speech-in-noise perception of ESL learners between the ages of seven and eight years in a multilingual country such as South Africa, by means of the SAAT and the DIN test. The results for the ESL learners were compared with those of a closely matched EFL group. The results of the two different tests that were used for the study provided information on the abovementioned auditory skills of ESL learners located in an urban area, from higher SES households and from the private schools included in this study.

Data analysis revealed insignificant differences between the two groups for the results obtained in the SAAT and DIN test respectively, with the ESL group performing similarly to the EFL group in both tests. The findings of the current study for the SAAT are not in agreement with previous research on selective auditory attention in ESL learners. The majority of the research reported that ESL learners experience severe difficulties when attending to and understanding speech in the presence of background noise (Venter, 2019; Warzybok et al., 2015). It is also important to note that in the competing stimulus listening conditions (lists 2 and 4) the ESL group achieved lower scores than the EFL group with the calculated probability value ($p=0.052$) close to being significant. This may indicate that if a larger sample size had been included in this study, a statistically significant difference might have been present for these lists.

The results obtained in the current study for the DIN test within the diotic listening condition are in agreement with previous research that found no significant second language effects on ESL speakers' ability to identify digit-triplets in noise presented diotically (Anderssen et al., 2019; Kaandorp et al., 2015). Studies done earlier determined that exposure to and acquisition of a second language at an early age could mediate the processing of speech in noise in the additional language with earlier exposure and acquisition related to performance similar to that of first language speakers (Bovo et al., 2018; Reetzke et al., 2016; Tabri et al., 2011). Various other studies, however, determined that perception of speech in noise is severely influenced when listening occurs in a second language (Dockrell & Shield, 2006; Lucks Mendel & Widner, 2016; Mayo et al., 1997; Tabri et al., 2011) and therefore do not agree with the findings from the current study. No significant differences were established within the antiphasic listening condition. De Sousa et al. (2019) and Wolmarans et al. (2021), who also evaluated the SRT of normal hearing participants and normal hearing children from seven years of age, found that during the antiphasic listening condition the DIN SRTs improved. This is in agreement with the results of the current study. The finding that the ESL learners who participated in the current study do not appear to be at a distinct disadvantage with regard to both spatially segregating speech from noise and understanding speech in the presence of background noise is supported by the insignificant difference in the BILD determined between the two participant groups.

Within the ESL group, the statistically significant negative correlation between the DIN in the diotic listening condition and the non-competing listening condition of the SAAT might be due to the lower linguistic demands of the stimuli used in these tests, as well as the ESL group's favourable exposure to English from a younger age than ESL learners in rural areas. The choice of speech material used when testing auditory processing skills can have a significant influence on performance (Anderssen et al., 2019). Accordingly, the strong negative agreement between these two measures suggests that the ESL learners who participated in this study do not experience greater difficulty than EFL learners in perceiving speech-in-noise and maintaining selective auditory attention in challenging listening environments, such as in a noisy classroom. This finding agrees with research that previously determined a relationship between improved speech-in-noise perception abilities and the development of auditory

processing efficiency, such as selective attention to auditory stimuli (Bovo et al., 2018; Elliot, 1979; Johnson, 2000; Moore, 2015). On the subject of attention, Klatte et al. (2013) suggested that the immature selective auditory attention abilities of children add to their struggle with speech perception in noise. The results of the current study, however, do not support this finding.

As indicated previously, the discrepancy between the current and previous studies may be due to the participants' more favourable exposure to English at an early age when compared to ESL learners located in rural areas with minimal English exposure when they reach school age. Although statistically significant differences were found between the mean age of first exposure to English through caregivers, family, and/or friends, the mean age of exposure (1.30 years ±1.04) of the ESL learners is still considerably lower than that of the majority of ESL learners in rural areas whose first exposure to English is generally only when they reach school age (Alejo & Piquer-Pìriz, 2016). Hossain (2016) investigated various factors that contribute to the difference of performance in English between learners located in rural and urban areas, and his results substantiate the current findings. It was found that factors such as SES and the availability of sufficient educational resources definitely contribute to the poor proficiency in English of ESL learners located in rural areas. Findings from the current study highlighted the influence of SES and age of exposure on English proficiency and in turn on selective auditory attention and speech in noise perception in ESL learners.

4.2. Clinical implications

The ESL learners who participated in this study were from private schools located in the Tshwane district of Gauteng, an urban area, and were thus from higher SES households. The findings seem to indicate that these learners do not appear to be at a distinct disadvantage when listening to speech in noise and having to pay selective auditory attention in the typical classroom environment. The fact that these findings are not in agreement with those of previous studies investigating either selective auditory attention (Venter, 2019) or speech-in-noise perception (Bovo et al., 2018; Florentine, 1985; Nelson et al., 2005; Tabri et al., 2011) in ESL speakers, highlighted

the influence of language proficiency on these skills. Proficiency (or lack of proficiency) in the LoLT was found by previous researchers to play a significant part in selective auditory attention and speech-in-noise perception in ESL learners.

Results from the current study substantiate previous findings regarding the influence of several external factors, such as choice of schools (privately or government funded), geographic location (i.e. urban, rural) and SES, on age of exposure to and acquisition of a second language (Alejo & Piquer-Pìriz, 2016; Hossain, 2016), which in turn impacts language proficiency and its effect on selective auditory attention and speech-in-noise perception in ESL learners. When a learner is identified as being an ESL speaker, it does not automatically imply that he/she is going to experience severe difficulties and a disadvantage when required to selectively attend to and understand speech in the presence of noise, such as in the typical classroom environment. It is, therefore, important for speech-language therapists and audiologists to focus more on the background history of an ESL patient in the clinical practice in terms of age of exposure to English when assessing auditory processing skills and the effect thereof on academic achievement.

4.3. Critical evaluation

A critical evaluation of the study is essential to guarantee that interpretation of the results occurs in accordance with the strengths and limitations which were identified.

4.3.1. Strengths of the study

- Findings from the current study called attention to the impact of SES and age of exposure on English proficiency and in turn on selective auditory attention and speech in noise perception in ESL learners.
- Results from the current study suggest that the use of the antiphasic listening condition improves the DIN SRTs in ESL learners. The finding is supported by the insignificant difference in the BILD established between the EFL and ESL groups.

- The participants in the research and control groups were closely matched for SES and from privately funded schools, which eliminated as many confounding variables as possible despite challenges experienced due to COVID-19-regulations.
- Possible participants who presented with ADHD, any learning disabilities, or head trauma were not included in this research study to ensure uncontaminated results.
- The SAAT and DIN test proved to be clinical reliable assessments to use with the population under investigation, namely ESL learners.

4.3.2. Limitations of the study

The limitations of this research study might have affected the results of the study and should be noted when interpreting the conclusions. The COVID-19 pandemic had a detrimental effect on the commencement of this study and led to time limitations. Due to the South African COVID-19-regulations implemented during the time of participant selection and data collection for the study, the researcher found it challenging to acquire more learners to participate. These challenges relating to COVID-19 influenced the following characteristics of the sample:

- The most significant limitation of this study was that the learners who participated in the study were recruited from three private schools, located in the Tshwane district, an urban area in the Gauteng province of South Africa and from higher SES households. In addition to the difficulties caused by COVID-19, the researcher had to obtain additional permission from the Department of Education to include learners who attend local government funded schools, which proved to be difficult. The study would, however, have benefitted from the inclusion of ESL learners located in rural areas, from lower SES households, and in government funded schools, to be representative of the larger population of school-aged ESL learners in South Africa. The fact that most of the learners in South Africa acquire their education in a rural setting restricts the viability of hypothesising that the results of the current study may be generalised to every educational setting in South Africa.

- The study population was a small sample. Consequently, the participants in the study could not be matched according to their age and gender, which should be taken into consideration when interpreting the results. Although the ages of the participants of the EFL and ESL groups did not differ statistically significantly and still fell within the strict participant description criteria, the median ages of the two participant groups (EFL median age = 7 years old; ESL median age = 8 years old) differed by one year. This could be one of the reasons why the ESL group's test results did not differ statistically significantly from those of the EFL group. The unequal number of male versus female participants may also have had an impact on the statistical findings obtained in the study.
- Even though SES was considered during participant selection as all participants were recruited from privately funded schools, stronger evidence of SES or a more nuanced distinction between the subclassifications of SES would have rendered valuable information. Such detail could be used to develop a better understanding of the influence of SES on language proficiency in ESL learners and, in due course, a greater understanding of the influence of language proficiency on selective auditory attention and speech-in-noise perception in ESL learners from high, middle, and low SES households. This would have resulted in improved potential for generalisation of results obtained. Describing difficulties with selective auditory attention and speech-in-noise perception experienced by ESL learners from various SES backgrounds, would have supported the appeal to develop effective strategies for addressing these challenges within various educational contexts in South Africa.
- It is important to take note that not all the participants' parents and/or guardians completed all the expected information in the case history questionnaire regarding age of exposure to English through various sources. This might have had an impact on the statistical analysis of age of exposure in each participant group and should be taken into consideration when interpreting the results.

4.4. Recommendations for future research

Several aspects of this study warrant further research. Firstly, only learners from private schools located in an urban area and thus (presumably) from higher socioeconomic backgrounds were included. Secondly, due to the COVID-19 pandemic, only a small sample size was included which restricted the ability to closely match participants according to age and gender. It is recommended that the study be replicated in a rural area and that school aged EFL and ESL learners (stringently matched for age and gender in each participant group) from government funded schools be included, as well as ESL learners from lower SES households in order to represent the majority of ESL learners in educational settings based in South Africa. Since previous research results regarding the difficulties ESL learners experience with selective auditory attention and speech-in-noise perception do not agree with the findings of the current study, additional research is warranted. Such research could lead to the development of strategies that will be effective in addressing the challenges that ESL learners may face in the wider South African context where lower SES and language proficiency of ESL learners could account for poorer auditory processing skills.

4.5. Conclusion

The main finding was that selective auditory attention and speech-in-noise perception abilities were not significantly affected in the ESL learners who participated in the study. The participants included in the current study were learners who were recruited from private schools located in an urban area and thus from higher SES households. This points to the possibility of additional or alternative factors that influence the acquisition of auditory processing skills of ESL learners in the multilingual South African context – factors that should be considered in the management of this unique group of learners.

5. REFERENCES

Aarabi, S., Jarollahi, F., & Jalaei, S. (2016). Development and determination of the validity of Persian version of monaural selective auditory attention test in learning disabled children. *Auditory and Vestibular Research Journal*, *25*(1), 49–54.

Al-Zoubi, S. M. (2018). The impact of exposure to English language on language acquisition. *Journal of Applied Linguistics and Language Research*, *5*(4), 151–162.

Alain, C., Reinke, K., He, Y., Wang, C., & Lobaugh, N. (2005). Hearing two things at once: Neurophysiological indices of speech segregation and identification. *Journal of Cognitive Neuroscience*, *17*(5), 811–818. https://doi.org/10.1162/0898929053747621

Alejo, R., & Piquer-Pìriz, A. (2016). Urban vs. rural CLIL: An analysis of input-related variables, motivation and language attainment. *Language, Culture and Curriculum*, 1–18. https://dx.doi.org/10.1080/07908318.2016.1154068

American National Standards Institute. (2002). *Acoustic performance criteria, design requirements and guidelines for schools.* ANSI S12.60.

American Speech-Language-Hearing Association. (2005). (Central) auditory processing disorders: The role of the audiologist. *American Speech-Language-Hearing Association*. https://www.asha.org/content.aspx?id=10737450473

Anderssen, K.-L., Kritzinger, A., & Pottas, L. (2019). Auditory skills and listening comprehension in English second language learners in Grade 1. *South African Journal of Childhood Education*, *9*(1), a600. https://doi.org/10.4102/sajce.v9i1.600

Auditec (2015). *Selective Auditory Attention Test (SAAT)*. Auditec, Inc. https://auditec.com/2015/08/04/selective-auditory-attention-test-saat/

Baker, C. (2006). Chapter 8: Cognitive theories of bilingualism and the curriculum. In *Foundations of bilingual education and bilingualism* (pp. 166–186).

Bellis, T. J. (2004). Understanding auditory processing disorders in children.

American Speech-Language-Hearing Association, 5167–5769.

Bellis, T. J. (2011). Chapter 2: Mechanisms of Selected Auditory and Related Processes. In T. J. Bellis (Ed.), *Assessment and Management of Central Auditory Processing Disorders in the Educational Setting: From Science to Practice* (Second, pp. 51–83). Plural Publishing Inc.

Blaikie, N., & Priest, J. (2019). *Designing social research: The logic of anticipation* (3rd ed.). John Wiley & Sons.

Bovo, R., Lovo, E., Astolfi, L., Montino, S., Franchella, S., Gallo, S., Prodi, N., Borsetto, D., & Trevisi, P. (2018). Speech perception in noise by young sequential bilingual children. *ACTA Othorhinolaryngologica Italica*, *38*, 536–543. https://doi.org/10.0.57.47/0392-100X-1846

British Society of Audiology. (2007). *Auditory Processing Disorder*. British Society of Audiology Steering Group. https://www.thebsa.org.uk/apd/Home

Brock-Utne, B., & Skattum, I. (2009). *Languages and education in Africa: A comprehensive and transdisciplinary analysis*. Symposium Books.

Bronkhorst, A. W. (2000). The cocktail party phenomenon: A review of research on speech intelligibility in multiple-talker conditions. *Acta Acustica United with Acustica*, *86*(1), 117–128.

Chang, A. C., Wu, B. W., & Pang, J. C. (2013). Second language listening difficulties perceived by low-level learners. *Perceptual and Motor Skills*, *116*(2), 415–434. doi: 10.2466/22.23.PMS.116.2.415-434%0A

Chermak, G. D., Hall, J., & Musiek, F. (1999). Differential diagnosis and management of central auditory processing disorder and attention deficit hyperactivity disorder. *Journal of American Academy of Audiology*, *6*, 289–303.

Chermak, G. D., & Montgomery, M. J. (1992). Form equivalence of the Selective Auditory Attention Test administered to 6-year-old children. *Journal of Speech, Language and Hearing Research*, *35*(3), 661–665. https://doi.org/10.1044/jshr.3503.661

Cherry, R. (1980). *Selective Auditory Attention Test*. Auditec.

Cherry, R., & Rubinstein, A. (2006). Comparing monotic and diotic selective auditory attention abilities in children. *Language, Speech, and Hearing Services in Schools*, *37*(2), 137–142. doi: 10.1044/0161-1461(2006/015)

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Ed.). Lawrence Erlbaum Associates, Publishers.

Cole, E., & Flexer, C. (2015). *Children with hearing loss: Developing listening and talking, birth to six*. Plural Publishing.

Collier, V. P. (1987a). Age and rate of acquisition of second language for academic purposes. *TESOL Quarterly, 21*, 617–641.

Collier, V. P. (1987b). The effect of age on acquisition of a second language for school. *New Focus, NCBE Occasional Papers in Bilingual Education Number 2*.

Collier, V. P., & Thomas, W. P. (1988). Acquisition of cognitive-academic second language proficiency: A six year study. [Paper Presentation]. 1988 Annual Meeting of the American Educational Research Association, New Orleans, LA, United States.

Constitution of the Republic of South Africa, 1996. https://www.refworld.org/docid/3ae6b5de4.html

Cummins, J. (2008). BICS and CALP: Empirical and theoretical status of the distinction. In N. H. Hornberger (Ed.), *Encyclopedia of Language and Education* (pp. 487–499). Springer.

Dawes, P., Bishop, D. V., Sirimanna, T., & Bamiou, D. E. (2008). Profile and aetiology of children diagnosed with auditory processing disorder (APD). *International Journal of Pediatric Othorhinolaryngology*, *72*(4), 483–489. doi: 10.1016/j.ijporl.2007.12.007

De Sousa, K. C., Swanepoel, D. W., Moore, D. R., Myburgh, H. C., & Smits, C. (2019). Improving sensitivity of the digits-in-noise test using antiphasic stimuli. *Ear and Hearing*, 1–9. doi: 10.1097/AUD.0000000000000775

Department of Health, Republic of South Africa. (2015). *Ethics in health research: Principles, processes and structures (2nd ed.)*. ru.ac.za/media/rhodesuniversity/content/ethics/documents/nationalguidelines/D

OH_(2015)_Ethics_in_health_research_Principles,_processes_and_structures.pdf

Dockrell, J. E., & Shield, B. M. (2006). Acoustical barriers in classrooms: The impact of noise on performance in the classroom. *British Educational Research Journal*, *32*(3), 509–525. doi: 10.1080/01411920600635494

Draucker, C. B., Martsolf, D. S., & Poole, C. (2009). Developing distress protocols for research on sensitive topics. *Archives of Psychiatric Nursing*, *23*(5), 343–350. doi: 10.1016/j.apnu.2008.10.008

Elliot, L. L. (1979). Performance of children aged 9 to 17 years on a test of speech intelligibility in noise using sentence material with controlled word predictability. *The Journal of the Acoustical Society of America*, *66*, 651–653.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175–191. https://doi.org/10.3758/BF03193146

Ferre, J. (2006). Management strategies for APD. In T. Parthasarathy (Ed.), *An Introduction to Auditory Processing Disorders in Children* (pp. 161–183). Lawrence Erlbaum Associates.

Field, A. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). SAGE.

Flexer, C. (2004). The impact of classroom acoustics: Listening, learning and literacy. *Seminars in Hearing*, *25*(2), 131–140. doi: 10.1055/s-2004-828664

Florentine, M. (1985). Speech perception in noise by fluent, nonnative listeners. *Proceedings of the Acoustical Society of Japan*, H-85-16.

Hall, K. (2021). *Child poverty*. Statistics on Children in South Africa. http://childrencount.uct.ac.za/indicator.php?domain=2&indicator=98

Hay, I., & Fielding-Barnsley, R. (2012). Social learning, language and literacy. *Australian Journal of Early Childhood*, *37*(1), 24–29. https://doi.org/10.1177/183693911203700104

Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies.

Evidence-Based Nursing, *18*, 66–67. http://dx.doi.org/10.1136/eb-2015-102129

Henning, E. (2012). Learning concepts, language, and literacy in hybrid linguistic codes: The multilingual maze of urban grade 1 classrooms in South Africa. *Perspectives in Education*, *30*(3), 69–77.

Heugh, K. (2009). Into the cauldron: An interplay of indigenous and globalised knowledge with strong and weak notions of literacy and language education in Ethiopia and South Africa. *Language Matters*, *40*, 166–189. https://doi.org/10.1080/10228190903188559

Hind, S. E., Haines-Bazrafshan, R., Benton, C. L., Brassington, W., Towle, B., & Moore, D. R. (2011). Prevalence of clinical referrals having hearing thresholds within normal limits. *International Journal of Audiology*, *50*(10), 708–716. doi: 10.3109/14992027.2011.582049

Hirsh, I. J. (1948). The influence of interaural phase on interaural summation and inhibition. *J Acoust Soc Audiol Am*, *20*, 536–544. https://doi.org/10.1121/1.1906407

Hoff, E. (2006). How social contexts support and shape language development. *Developmental Review*, *26*(1), 55–88. https://doi.org/10.1016/j.dr.2005.11.002

Hoff, E. (2013). Interpreting the early language trajectories of children from low SES and language minority homes: Implications for closing achievement gaps. *Developmental Psychology*, *49*(1), 4–14. https://doi.org/10.1037/a0027238

Holt, L. L., & Lotto, A. J. (2010). Speech perception as categorization. *Attention, Perception and Psychophysics*, *72*(5), 1218–1227. doi: 10.3758/APP.72.5.1218

Hossain, M. M. (2016). English language teaching in rural areas: A scenario and problems and prospects in context of Bangladesh. *Advances in Language and Literacy Studies*, *7*(3), 1–12.

IBM Corporation. (2019). *IBM SPSS Statistics for Windows* (26.0). NY: IBM Corp. https://www.ibm.com/products/spss-statistics

Isbell, E., Wray, A. H., & Neville, H. J. (2016). Individual differences in neural mechanisms of selective auditory attention in preschoolers from lower socioeconomic status backgrounds: An event-related potentials study.

Developmental Science, *19*(6), 865–880. doi: 10.1111/desc.12334

Jansen, S., Luts, H., Wagener, K. C., Franchet, B., & Wouters, J. (2010). The French digit triplet test: A hearing screening tool for speech intelligibility in noise. *International Journal of Audiology*, *49*(5), 378–387. doi: 10.3109/14992020903431272

Johnson, C. E. (2000). Children's phoneme identification in reverberation and noise. *The Journal of Speech, Language, and Hearing Research*, *43*, 144–157.

Kaandorp, M., De Groot, A., Festen, J., Smits, C., & Goverts, S. (2015). The influence of lexical-access ability and vocabulary knowledge on measure of speech recognition in noise. *International Journal of Audiology*, *55*, 157167. http://dx.doi.org/10.3109/14992027.2015.1104735

Kapp, R. (2004). Reading on the line: An analysis of literacy practices in ESL classes in a South African township school. *Journal of Language and Education*, *18*(1), 246–263.

Katz, J. (2014). *Handbook of clinical audiology* (7th ed.). Wolters Kluwer Health.

Kendall, M. (2003). Designing a research project: Randomised controlled trials and their principles. *Emergency Medicine Journal*, *20*, 164–168.

Khavarghazalani, B., Farahani, F., Emadi, M., & Dastgerdi, Z. H. (2016). Auditory processing abilities in children with chronic otitis media with effusion. *Acta Oto-Laryngologica*, *136*(5), 456–459. https://doi.org/10.3109/00016489.2015.1129552

Kidd, G., Mason, C. R., Best, V., & Marrone, N. (2010). Stimulus factors influencing spatial release from speech-on-speech masking. *The Journal of the Acoustical Society of America*, *128*(4), 1965–1978. doi: 10.1121/1.3478781

Klatte, M., Bergström, K., & Lachmann, T. (2013). Does noise affect learning? A short review on noise effects on cognitive performance in children. *Frontiers in Psychology*, *4*, 1–6. https://doi.org/10.3389/fpsyg.2013.00578

Kollmeier, B., Warzybok, A., Hochmuth, S., Zokoll, M. A., Uslar, V., Brand, T., & Wagener, K. C. (2015). The multilingual matrix test: Principles, applications and comparisons across languages: A review. *International Journal of Audiology*,

54(2), 3–16. doi: 10.3109/14992027.2015.1020971

Koopsman, W. J. A., Goverts, S. T., & Smits, C. (2018). Speech recognition abilities in normal-hearing children 4 to 12 years of age in stationary and interrupted noise. *Ear and Hearing*, *39*(6), 1091–1103. doi: 10.1097/AUD.0000000000000569

Kotzé, E., & Hibbert, L. (2010). Are multilingual education policies pipe dreams? *Interdisciplinary Journal for the Study of the Arts and Humanities in Southern Africa*, *17*(1), 4–25.

Kousaie, S., Baum, S., Phillips, N. A., Gracco, V., Titone, D., Chen, J. K., Chai, X. J., & Klein, D. (2019). Language learning experience and mastering the challenges of perceiving speech in noise. *Brain and Language*, *196*, 1–9. https://doi.org/10.1016/j.bandl.2019.104645

Landsberg, E., Kruger, D., & Swart, E. (2016). *Addressing barriers to learning: A South African perspective* (3rd ed.). Van Schaik.

Lanzetta-Valdo, B. P., De Oliveira, G. A., Ferreira, J. T. C., & Palacios, E. M. N. (2017). Auditory processing assessment in children with Attention Deficit Hyperactivity Disorder: An open study examining methylphenidate effects. *International Archives of Otorhinolaryngology*, *21*(1), 72–78. doi: 10.1055/s-0036-1572526

Leedy, P. D., & Ormrod, J. E. (2005). *Practical research: Planning and design* (8th ed.). Pearson.

Leedy, P. D., & Ormrod, J. E. (2013). *Practical research: Planning and design* (10th ed.). Pearson.

Lewis, M. P. (2009). *Table 1: Distribution of languages by area of origin*. Ethnologue, SIL International.

Licklider, J. C. R. (1948). The influence of interaural phase relations upon the masking of speech by white noise. *The Journal of the Acoustical Society of America*, *20*(2), 150–159. https://doi.org/10.1121/1.1906358

Lucks Mendel, L., & Widner, H. (2016). Speech perception in noise for bilingual listeners with normal hearing. *International Journal of Audiology*, *55*(2), 126–

134.

Margolis, R. H., Wilson, R. H., Popelka, G. R., Eikelboom, R. H., Swanepoel, D. W., & Saly, G. L. (2015). Distribution characteristics of normal pure-tone thresholds. *International Journal of Audiology*, *54*(11), 796–205. doi: 10.3109/14992027.2015.1033656

Maxwell, D. L., & Satake, E. (2006). *Research and statistical methods in communication sciences and disorders*. Thomson/Delmar Learning.

Mayo, L. H., Florentine, M., & Buus, S. (1997). Age of second-language acquisition and perception of speech in noise. *Journal of Speech, Language and Hearing Research*, *40*(3), 686–693.

McCullagh, J., & Bamiou, D. E. (2014). Measures of binaural interaction. In F. E. Musiek & G. D. Chermak (Eds.), *Handbook of central auditory processing disorders: Auditory neuroscience and diagnosis* (pp. 435–469). Plural Publishing.

Moonsamy, S., & Kathard, H. (2015). *Speech-language therapy in a school context - Principles and practices*. Van Schaik.

Moore, D. R. (2007). Auditory processing disorders: Acquisition and treatment. *Journal of Communication Disorders*, *40*(4), 295–304. https://doi.org/10.1016/j.jcomdis.2007.03.005

Moore, D. R. (2015). Maturation and aging. In J. J. Eggermont (Ed.), *Auditory temporal processing and its disorders*. Oxford University Press.

Morrow, N., Jordaan, H., & Fridjhon, P. (2005). The effects of educational context on the understanding of linguistic concepts in English and isiZulu by Grade 7 learners. *South African Journal of Education*, *25*(3), 164–169.

Nassaji, H. (2015). Qualitative and descriptive research: Data type versus data analysis. *Language Teaching Research*, *19*(2), 129–132. https://doi.org/10.1177/1362168815572747

National Health Act No. 61, 2003, Pub. L. No. 61 (2004).

Ndimande-Hlongwa, N., & Wildsmith-Cromarty, R. (2010). Multilingualism for access,

language development and language intellectualisation. *Interdisciplinary Journal for the Study of the Arts and Humanities in Southern Africa*, *17*(1), 92–105.

Nelson, P., Kohnert, K., Sabur, S., & Shaw, D. (2005). Classroom noise and children learning through a second language: Double jeopardy? *Language, Speech, and Hearing Services in Schools*, *36*(3), 219–229. https://doi.org/10.1044/0161-1461(2005/022)

Nieman, M., & Hugo, A. (2010). Using English as a second language as the language of instruction: Concerns and needs of primary school teachers in South Africa. *Journal of Language Teaching*, *44*(1), 59–69. doi: 10.4314/jlt.v44i1.71781

Owens, R. E., & Owens, R. E. (2012). *Language development: An introduction* (8th ed.). Pearson.

Pandor, N. (2006). *Address by the Minister of Education, Naledi Pandor, MP, at the language colloquium, Cape Town*. http://www.info.gov.za/speeches/2006/06080114451001.htm

Parker, R. B. (2001). A definition of privacy. In E. Barendt (Ed.), *Privacy*. Routledge.

Potgieter, J. M., Swanepoel, D. W., Myburgh, H. C., Hopper, T. C., & Smits, C. (2016). Development and validation of a smartphone-based digits-in-noise hearing test in South African English. *International Journal of Audiology*, *55*(7), 405–411. doi: 10.3109/14992027.2016.1172269

Pretorius, E. J. (2002). Reading ability and academic performance in South Africa: Are we fiddling while Rome is burning? *Language Matters - Studies in the Languages of Africa*, *33*(1), 169–196. https://doi.org/10.1080/10228190208566183

Rahman, T. T. A., Mohamed, S. T., Albanouby, M. H., & Bekhet, H. F. (2011). Central auditory processing in elderly with mild cognitive impairment. *Geriatrics Gerontology International*, *11*, 304–308.

Reetzke, R., Lam, B. P., Xie, Z., Sheng, L., & Chandrasekaran, B. (2016). Effect of simultaneous bilingualism on speech intelligibility accross different masker types, modalities, and signal-to-noise ratios in school-aged children. *PLoS ONE*,

11, *12*, 1–19. https://doi.org/10.1371/journal.pone.0168048

Richard, G. J. (2019). Language Processing versus Auditory Processing. In D. Geffner & D. Ross-Swain (Eds.), *Auditory Processing Disorders - Assessment, Managementm and Treatment* (Third, pp. 224–226). Plural Publishing Inc.

Rogers, C. L., Lister, J. J., Febo, D. M., Besing, J. M., & Abrams, H. B. (2006). Effects of bilingualism, noise, and reverberation on speech perception by listeners with normal hearing. *Applied Psycholinguistics*, *27*, 465–485. doi: 10.1017.S014271640606036X

Ross, D. S., Holstrum, W. J., Gaffney, M., Green, D., Oyler, R. F., & Gravel, J. S. (2008). Hearing screening and diagnostic evaluation of children with unilateral and mild bilateral hearing loss. *Trends in Amplification*, *12*(1), 27–34. doi: 10.1177/1084713807306241

Salkind, N. J. (2010). *Encyclopedia of research design*. SAGE Publications Ltd.

Saniei, A. (2011). Who is an ideal native speaker? in D. Chen (Ed.), *2011 International Conference on Languages, Literature and Linguistics, (pp. 74-78). IACSIT Press*.

Schafer, E. C., Bryant, D., Sanders, K., Baldus, N., Lewis, A., Traber, J., & Algier, K. (2013). Listening comprehension in background noise in children with normal hearing. *Journal of Educational Audiology*, *19*, 58–64.

Setia, M. S. (2016). Methodology series module 5: Sampling strategies. *Indian Journal of Dermatology*, *61*(5), 505. doi: 10.4103/0019-5154.190118

Sharma, M., Purdy, S. C., & Kelly, A. S. (2009). Comorbidity of Auditory Processing, Language, and Reading Disorders. *Journal of Speech, Language, and Hearing Research*, *52*(3), 706–722. https://doi.org/10.1044/1092-4388(2008/07-0226)

Shi, L. F. (2010). Perception of acoustically degraded sentences in bilingual listeners who differ in age of english acquisition. *Journal of Speech, Language and Hearing Research*, *53*(4), 821–835. https://doi.org/10.1044/1092-4388(2010/09-0081)

Shield, B. M., & Dockrell, J. E. (2008). The effects of environmental and classroom noise on the academic attainments of primary school children. *The Journal of*

the Acoustical Society of America, *123*(1), 133–144. https://doi.org/10.1121/1.2812596

Smits, C., Goverts, S. T., & Festen, J. M. (2013). The digits-in-noise test: Assessing auditory speech recognition abilities in noise. *The Journal of the Acoustical Society of America*, *133*(3), 1693–1706. https://doi.org/10.1121/1.4789933

Smits, C., Kapteyn, T. S., & Houtgast, T. (2004). Development and validation of an automatic speech-in-noise screening test by telephone. *International Journal of Audiology*, *43*, 15–28.

South African National Department of Basic Education. (2010). *Report on the 2009/2010 annual survey for ordinary schools*. South Africa: Department of Basic Education. www.gov.za/sites/default/files/gcis_document/201409/report-2009-2010-annual-surveys-ordinary-schools.pdf

Spaull, N. (2016). Disentangling the language effect in South African schools: Measuring the impact of “language of assessment” in grade 3 literacy and numeracy. *South African Journal of Childhood Education*, *6*(1), 1–20. doi: 10.4102/sajce.v6i1.475

Statistics South Africa. (2012). *Census 2011: Census in brief*. Statistics South Africa. http://www.statssa.gov.za/census/census_2011/census_products/Census_2011_Census_in_brief.pdf

Stevens, C., & Bavelier, D. (2012). The role of selective attention on academic foundations: A cognitive neuroscience perspective. *Developmental Cognitive Neuroscience*, *2*(SUPPL. 1), S30–S48. https://doi.org/10.1016/j.dcn.2011.11.001

Strait, D. L., & Kraus, N. (2011). Can you hear me now? Musical training shapes functional brain networks for selective auditory attention and hearing speech in noise. *Frontiers in Psychology*, *2*(JUN), 1–10. https://doi.org/10.3389/fpsyg.2011.00113

Swanepoel, D. W., Myburgh, H. C., Howe, D. M., Mahomed, F., & Eikelboom, R. H. (2014). Smartphone hearing screening with integrated quality control and data management. *International Journal of Audiology*, *53*(12), 841–849. doi:

10.3109/14992027.2014.920965

Tabri, D., Chacra, K. M. S. A., & Pring, T. (2011). Speech perception in noise by monolingual, bilingual and trilingual listeners. *International Journal of Language and Communication Disorders*, *46*(4), 411–422. doi: 10.3109/13682822.2010.519372

Talcott, J. B., Witton, C., Hebb, G. S., Stoodley, C. J., Westwood, E. A., France, S. J., Hansen, P. C., & Stein, J. F. (2002). On the relationship between dynamic visual and auditory processing and literacy skills; results from a large primary-school study. *Dyslexia*, *8*(4), 204–225. https://doi.org/10.1002/dys.224

Taylor, S., & von Fintel, M. (2016). Estimating the impact of language of instruction in South African primary schools: A fixed effects approach. *Economics of Education Review*, *50*, 75–89. http://doi.org/10.1016/j.econedurev.2016.01.003

University of Pretoria. (2018). *Code of ethics for research*. University of Pretoria. https://www.up.ac.za/media/shared/Legacy/sitefiles/file/45/2875/code_ethics_researchrt42999.pdf

Vandergrift, L. (2004). Listening to learn or learning to listen. *Annual Review of Applied Linguistics*, *24*, 3–25. doi:10.1017/S0267190504000017

Vandergrift, L., & Goh, C. C. (2018). *Teaching English to Second Language Learners in Academic Contexts*. Routledge.

Venter, C. (2019). *Selective auditory attention and listening comprehension in English additional language learners* [MA Dissertation, University of Pretoria]. UPSpace Institutional Repository. http://hdl.handle.net/2263/72711

Warzybok, A., Brand, T., Wagener, K. C., & Kollmeier, B. (2015). How much does language proficiency by non-native listeners influence speech audiometric tests in noise? *International Journal of Audiology*, *54*(sup2), 88–99. doi: 10.3109/14992027.2015.1063715

Watson, R. (2015). Quantitative research. *Nursing Standard*, *29*(31). https://doi.org/10.7748/ns.29.31.44.e8681

Webb, V., Lafon, M., & Pare, P. (2010). Bantu languages in education in South Africa: An overview. Ongekho akekho! - The absentee owner. *South African*

Journal of Childhood Education, *38*(3), 273–292. https://doi.org/10.1080/09571730903208389

Wible, B., Nicol, T., & Kraus, N. (2005). Correlation between brainstem and cortical auditory processes in normal and language-impaired children. *Brain*, *128*(2), 417–423. https://doi.org/10.1093/brain/awh367

Wildschut, Z., Moodley, T., & Aronstam, S. (2016). The baseline assessment of Grade 1 learners' literacy skills in a socio-economically disadvantaged school setting. *South African Journal of Childhood Education*, *6*(1), 1–9. https://doi.org/10.4102/sajce.v6i1.340

Wolmarans, J., De Sousa, K. C., Frisby, C., Mahomed-Asmail, F., Smits, C., Moore, D. R., & Swanepoel, D. W. (2021). Speech recognition in noise using binaural diotic and antiphasic Digits-In-Noise in children: Maturation and self-test validity. *Journal of the American Academy of Audiology*, *32*(5), 315–323.

Yilmaz, H., & Yavuz, F. (2015). The problems young learners encounter during listening skills. *Procedia - Social and Behavioral Sciences*, *197*, 2046–2050. https://doi.org/10.1016/j.sbspro.2015.07.570

Zokoll, M. A., Wagener, K. C., Brand, T., Buschermöhle, M., & Kollmeier, B. (2012). Internationally comparable screening tests for listening in noise in several European languages: The German digit triplet test as an optimization prototype. *International Journal of Audiology*, *51*(9), 697-aaaa707. https://doi.org/10.3109/14992027.2012.690078

List of appendices

Appendix A: Ethical clearance letter from the Faculty of Humanities' Research Ethics Committee

Appendix A

Faculty of Humanities
Fakulteit Geesteswetenskappe
Lefapha la Bomotho

Humanities 100.
Since 1913

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

2 June 2020

Dear Miss L Strydom

Project Title:	Selective auditory attention and speech-in-noise perception in English second language learners
Researcher:	Miss L Strydom
Supervisor:	Prof L Pottas
Department:	Speech Language Path and Aud
Reference number:	15183514 (HUM006/0320)
Degree:	Masters

I have pleasure in informing you that the above application was approved by the Research Ethics Committee on 28 May 2020. Data collection may therefore commence.

Please note that this approval is based on the assumption that the research will be carried out along the lines laid out in the proposal. Should the actual research depart significantly from the proposed research, it will be necessary to apply for a new research approval and ethical clearance.

- Permission is required from the school(s)

We wish you success with the project.

Sincerely,

Prof Innocent Pikirayi
Deputy Dean: Postgraduate Studies and Research Ethics
Faculty of Humanities
UNIVERSITY OF PRETORIA
e-mail: PGHumanities@up.ac.za

Fakulteit Geesteswetenskappe
Lefapha la Bomotho

Research Ethics Committee Members: Prof I Pikirayi (Deputy Dean); Prof KL Harris; Mr A Bizos; Dr A-M de Beer; Dr A dos Santos; Ms KT Govinder; Andrew...Dr P Kukura; Dr E Johnson; Prof D Maree; Mr A Mohamed; Dr I Nooroli; Dr C Ruttergill; Prof D Reyburn; Prof M Soer; Prof E Tallard; Prof V Thebe; Ms B Tsebe; Ms D Mokalapa

Appendix B: School information letter and informed consent forms from private schools

UNIVERSITEIT VAN PRETORIA
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Appendix B

Faculty of Humanities
Department of Speech-Language Pathology and Audiology

July 2020

Dear principal

PERMISSION FOR PARTICIPATION IN A RESEARCH STUDY

I am an Audiology postgraduate student at the University of Pretoria. I am investigating the selective auditory attention abilities and speech-in-noise perception of English second language learners. I would hereby please request your permission to be allowed to conduct the study at your school.

Through the process of selective auditory attention, a specific input is extracted and focused on for further processing, while irrelevant or distracting information is simultaneously suppressed. This skill is essential for a learner to establish the academic foundations of language, literacy, and mathematics. Taking into consideration that the typical classroom environment overflows with auditory and visual distractions, the role of selective auditory attention and speech-in-noise perception cannot be underestimated. The distractions in the typical classroom create a challenging situation for a child who has to focus on the teacher's instructions or on the task at hand. The auditory system needs to learn to adapt to a variety of listening conditions in order to extract specific information Selective auditory attention provides the process needed to attend to a target signal and suppress any competing noise for speech-in-noise perception to occur at a deep and profound level.

Considering the challenges that an ESL learner may experience within typical classroom settings, additional research is warranted to determine how ESL learners in a multilingual country such as South Africa perform in maintaining selective auditory attention and perceive speech in the presence of noise in order to suggest guidelines for facilitating teaching and learning in the classroom.

For the study, 40 children between the ages of seven and eight years will be selected. The research group will consist of 20 participants with English as their second language, and the control group of 20 participants with English as their first language. During the selection process it will be determined if the participant is a candidate for participation through a case history questionnaire that is to be completed by the participant's parent and/or guardian, as well as an audiological assessment that will be performed.

Participants with normal hearing sensitivity, intact middle ear functioning, and normal cognitive abilities will be selected for the study. If the parent and/or guardian gives consent for his/her child to participate in the research study and the child is selected during the selection process, he/she will be required to take part in one testing session which will take approximately 40 minutes.

Confidentiality regarding each participant's identity, personal information, and results will be assured by the researcher. Participants will be assigned a unique code to ensure that no identifying information about the participant will be disclosed during the data analysis. All research data obtained will be stored on the University of Pretoria's repository in electronic format for a minimum period of 15 years. All of the relevant results will be compiled in a research report, which will be available at the University of Pretoria.

I am aware that the Covid-19 pandemic is of a great concern for most parents and/or guardians. Therefore, precautionary measures have been put into place, in order to allow safety when testing a participant. These precautions are as follow:

- If the participant/researcher presents with any symptoms of COVID-19 or is feeling ill a day before the scheduled dates for testing, it has to be communicated and the appointment will be cancelled and rescheduled.
- If the participant/researcher shows symptoms or seems ill when arriving at the testing station, the session will be immediately cancelled and will not take place.
- A short questionnaire covering possible symptoms will be presented verbally to the participant to be completed.
- The participant's temperature will be measured with a thermometer to determine if he/she has a fever.
- The wearing of masks will be compulsory for all parties involved during testing.
- No physical contact will be allowed when greeting.
- A distance of at least one meter will be maintained as far as possible.
- The participant's hands will be sanitized with the available sanitizing products upon entering the session.
- Gloves will be made available for use.
- At the end of the session, the participant's hands will be sanitized again before he/she returns to class.

These precautions will also be communicated to the participants and the parent and/or guardian of the potential participants in the information and consent letter.

Participation in this research is completely voluntary. The participants' parent and/or guardian will be requested to provide written consent for their child to participate in the study. Assent will be obtained from the under-aged participants before commencement

of the study. Participants will be asked to mark "yes" or "no" on the assent form to provide assent to participate in the study. The participants will be informed before any testing of their right to withdraw immediately from the study at any given time if they wish to do so. The participants will be protected from any physical or psychological harm, their comfort and safety will be ensured, and they will be treated in a respectful manner. It is envisaged that the information that will be obtained from this study may help to gain insight and a better understanding of some elements of auditory processing, which may assist educators with regard to some principles of the education process.

Your attention regarding this request will be highly appreciated. Please do not hesitate to contact the researcher, Lianca Strydom, should any further information be required.

Kind regards,

Ms Lianca Strydom
Cell: 0608261200
Email: liancastrydom62@gmail.com

Supervisor
Prof Lidia Pottas
Email: lidia.pottas@up.ac.za

Supervisor
Prof Maggi Soer
Email: maggi.soer@up.ac.za

Informed consent – Hatfield Christian School

INFORMED CONSENT TO PARTICIPATE IN THE RESEARCH STUDY:

Title of study: Selective auditory attention, binaural integration, and speech-in-noise listening abilities in English second language learners

Please complete the following and return to the researcher:

I, the principal, Felicity Barber on behalf of Andrew Bleeker, of Hatfield Christian, hereby confirm that I have read and understood the information provided on the nature, conduct, benefits and risks of this research study. I hereby provide consent that this research study may be conducted on learners of Hatfield (SCHOOL NAME) School. I, the principal, understand that I do so voluntarily and that the participants may withdraw from this study at any time. I also understand that any personal details and data will be kept confidential and will only be used for research purposes in accordance with the information provided in the information letter.

School's name:
(Please print)
Hatfield Christian School

Principal's name and surname:
(Please print)
Felicity Barber on behalf of Andrew Bleeker.

Signature of principal:
pp Barber.

Date:
7 Sept 2020.

Contact number(s):
fbarber@hatfields.co.za
012 361 1182

Faculty of Humanities
Department of Speech-Language Pathology and Audiology
Fakulteit Geesteswetenskappe
Departement Spraak-Taalpatologie en Oudiologie
Lefapha la Bomotho
Kgoro ya Phatholotši ya Polelo-Maleme le Go kwa

Informed consent – Loreto Convent School

INFORMED CONSENT TO THE RESEARCH STUDY:

Title of study: Selective auditory attention, binaural integration, and speech-in-noise listening abilities in English second language learners

Please complete the following and return to the researcher:

I, the principal, Michelle Hill, of Loreto Convent School, hereby confirm that I have read and understood the information provided on the nature, conduct, benefits and risks of this research study. I hereby provide consent that this research study may be conducted on learners at Loreto Convent School. I understand that I do so voluntarily and that the learners may withdraw from this study at any time. I also understand that any personal details and data will be kept strictly confidential for research purposes in accordance with the information provided in the information letter.

School's name:
(Please print) Loreto Convent School

Principal's name and surname:
(Please print) Ms. M. Hill

Signature of principal:

Date: 19-2-2020

Contact number(s): 012-326 6342

LORETO CONVENT SCHOOL
131 Nana Sita Street
Pretoria
2020 -02- 19
EMIS 700231043
Tel. 012 326 6342

Informed consent – Zambezi Akademie

INFORMED CONSENT TO PARTICIPATE IN THE RESEARCH STUDY:

Title of study: Selective auditory attention, binaural integration, and speech-in-noise listening abilities in English second language learners

Please complete the following and return to the researcher:

I, the principal, (NAME: SURNAME) Jm Prozesky, of Zambesi Akademie (SCHOOL NAME), hereby confirm that I have read and understood the information provided on the nature, conduct, benefits and risks of this research study. I hereby provide consent that this research study may be conducted on learners of Zambesi Akademie (SCHOOL NAME). I, the principal, understand that I do so voluntarily and that the participants may withdraw from this study at any time. I also understand that any personal details and data will be kept confidential and will only be used for research purposes in accordance with the information provided in the information letter.

School's name: *(Please print)* Zambesi Akademie

Principal's name and surname: *(Please print)* Jm Prozesky

Signature of principal: Prozesky

Date: 2020-11-03

Contact number(s): 0724829257.

ZAMBESI AKADEMIE
PEACHPLACE STR 201
MAGALIESKRUIN 0182
072 174 4834
melanie@zambesiakademie.co.za

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Departement Spraak-Taalpatologie en Oudiologie
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Appendix C: Parent and/or guardian information letter and informed consent form

Appendix C

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Faculty of Humanities
Department of Speech-Language Pathology and Audiology

Dear parent and/or guardian

REQUEST FOR PARTICIPATION IN A RESEARCH STUDY

Thank you for your consideration regarding your child's possible participation in my research study. Information about the study, as well as what your child can expect during data collection are detailed in this letter. Please read the information and complete the consent form should you decide to allow your child to participate in the research.

The purpose of the study is to determine the selective auditory attention abilities and speech-in-noise perception in English second language learners. Selective auditory attention can be described as the process needed to attend to a target signal and suppress any competing noise. Speech-in-noise perception refers to the ability to perceive and comprehend speech in the presence of background noise. These skills are necessary for a learner to follow the specific instructions given verbally by a teacher in a noisy classroom environment, which in turn will enhance academic performance.

The Selective Auditory Attention Test (SAAT) is a speech-in-competing-message test and will be used to determine possible participants' ability to understand speech in the presence of background noise. The South African Digits-in-Noise (DIN) test, with in-

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Tel +27 (0)12 420 2357
Fax +27 (0)12 420 5678
lidia.pottas@up.ac.za
www.up.ac.za

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phase and out-of-phase listening conditions, will be used to evaluate the possible participants' ability to recognize speech in the presence of noise. The results obtained in the study may be beneficial as it could lead to a better understanding of how auditory processing difficulties may affect learners during their daily activities in the classroom environment.

Participation in the research study is completely voluntary, which means that you can choose if your child may participate or not, and you may say no or withdraw your child from the study at any time without any negative consequences. Assent will also be obtained from your child prior to the commencement of any testing. The testing procedure will be explained verbally along with the use of pictures to the child. Your child will be asked to mark "yes" or "no" on the assent form to provide assent to participate in the study. Your child will be protected from any physical or psychological harm, the comfort and safety of your child will be ensured, and he/she will be treated in a respectful manner.

Your child will be informed before any testing of his/her right to withdraw from the study at any time if he/she wishes to do so. Confidentiality of the participants' personal information and audiometric results will be ensured. The information will only be accessible to the researcher and to the parent and/or guardian of the participants. Participants will be designated a code number to ensure confidentiality.

For this study children in the age group seven to eight years old with normal audiometric results are required. During the selection process it will be determined if the child participant is a candidate to participate in the study through a case study questionnaire that is to be completed by you, as the parent or guardian of the participant. An audiological assessment will also be performed to determine

candidacy. The case history questionnaire contains questions in order to be able to obtain information regarding the potential participant's personal history which may affect the research outcomes. Participants with normal hearing sensitivity, intact middle ear functioning, and normal cognitive abilities will be selected for the study. In the case where a child presents with abnormal results, he/she will be referred by the researcher for diagnostic hearing tests and/or further intervention to the Department of Speech-Language Pathology and Audiology at the University of Pretoria.

The testing will be conducted during school hours within a relatively quiet environment, e.g. the staff room or a quiet classroom. If your child chooses to participate in this research and is selected during the selection process, he/she will be required to take part in one testing session which will take approximately 40 minutes. Benefits of participation include a free screening of your child's hearing, as well as his/her speech perception abilities.

The COVID-19 pandemic is of a great concern for everyone. Therefore, precautionary measures have been put into place in order to allow safety when testing your child. These precautions are as follow:

- If the participant/researcher presents with any symptoms of COVID-19 or is feeling ill a day before the scheduled dates for testing, it has to be communicated and the appointment will be cancelled and rescheduled.
- If the participant/researcher shows symptoms or seems ill when arriving at the testing station, the session will be immediately cancelled and will not take place.
- A short questionnaire covering possible symptoms will be presented verbally to the participant to be completed.
- The participant's temperature will be measured with a thermometer to determine if he/she has a fever.

- The wearing of masks will be compulsory for all parties involved during testing.
- No physical contact will be allowed when greeting.
- A distance of at least one meter will be maintained as far as possible.
- The participant's hands will be sanitized with the available sanitizing products upon entering the session.
- Gloves will be made available for use.
- At the end of the session, the participant's hands will be sanitized again before he/she returned to class.

Contact details

If you have any questions or concerns regarding any aspect of this study, please feel free to contact the researcher, Lianca Strydom.

Kind regards

Researcher

Ms. Lianca Strydom

Tel: 060 826 1200

E-mail: liancastrydom62@gmail.com

Supervisor

Prof. Lidia Pottas

E-mail: lidia.pottas@up.ac.za

Supervisor

Prof. Maggi Soer

E-mail: maggi.soer@up.ac.za

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INFORMED CONSENT TO PARTICIPATE IN THE RESEARCH STUDY:

Title of study: Selective auditory attention and speech-in-noise perception in English second language learners

Please complete the following and return to the school:

I, the parent/ guardian, hereby confirm that I have read and understood the information provided on the nature, conduct, benefits, and risks of the above research study. I hereby provide consent that my child may participate in this research study. I understand that I do so voluntarily and that he/she may withdraw from this study at any time. I also understand that any personal details and data will be confidentially processed and used for research purposes in accordance with the information provided in the information letter.

Child's name: _____

(Please print)

Parent/ guardian's name: _____

(Please print)

Signature of parent/ guardian: _____

Date: _____

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Appendix D: Participant information letter and informed assent form

Appendix D

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
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Faculty of Humanities
Department of Speech-Language Pathology and Audiology

INFORMED ASSENT TO THE RESEARCH STUDY:

Selective auditory attention and speech-in-noise perception in English second language learners

Name and surname: _____

School: _____

Good day, my name is Lianca Strydom. I am an audiologist, and I would like to learn more about your hearing.

1) I will use a light to look into your ear. This may tickle a bit.

2) I will place this plastic tip into your ear. You don't have to do anything. You can just sit still.

3) We will have a look at which sounds you can hear. I am going to put headphones on your ears. Each time that you hear the beep-beep sound, you quickly put up your hand to indicate to me that you have heard it.

4) You are going to listen to a few words and you should then show to me in the book provided which word you heard.

5) You will listen to different numbers through the headphones that I will put on your ears. I will ask you to enter the numbers that you heard, on the cell phone.

6) If you want to stop or go back to class, you can tell me or point to the stop sign. Then we will go back to class. Nobody will be mad at you if you want to stop.

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	Do you understand everything that I explained to you?	✓ YES / ✗ NO
	Do you understand that it is your choice to help met today?	✓ YES / ✗ NO
	Do you understand that you can stop at any time if you want?	✓ YES / ✗ NO
	Do you have any questions?	✓ YES / ✗ NO
	Do you understand the way I answered your questions?	✓ YES / ✗ NO
	Do you want to work with me today?	✓ YES / ✗ NO

Thank you

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Lianca Strydom *(Researcher)*

Prof. Lidia Pottas *(Supervisor)*

Prof. Maggi Soer *(Supervisor)*

Faculty of Humanities
Department of Speech-Language Pathology and Audiology
Fakulteit Geesteswetenskappe
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Appendix E: Participant pass or referral letter

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Appendix E

Faculty of Humanities
Department of Speech-Language Pathology and Audiology

Dear parents and/or guardians

Thank you for your consideration regarding your child's participation in my research study.

An otoscopic examination was administered in order to determine your child's outer ear's status, which include the external ear canal, as well as the tympanic membrane bilaterally. Results obtained are as follow:

Right ear	
Left ear	

Tympanometry was done, which is an objective test used to determine your child's middle ear functioning by measuring the ear canal volume, the compliance of the tympanic membrane (eardrum), as well as middle ear pressure of each ear. Results obtained are as follow:

	Right ear	**Left ear**
Middle ear pressure	daPa	daPa
Static compliance	ml	ml
Ear canal volume	ml	ml
Comments		

A hearing screening was also done to determine your child's hearing sensitivity. Results obtained are as follow:

Pass / refer	Comments
Right ear	
PASS	
REFER	
Left ear	
PASS	
REFER	

The Selective Auditory Attention Test is a speech-in-competing-message test and will be used to determine the participants' ability to understand speech in the presence of background noise. The non-competing sub-test gives a speech discrimination score in quiet. The competing sub-test gives a speech discrimination score in the presence of background noise; this sub-test was constructed such that even individuals with good selective attention abilities will have greater difficulty than when listening in quiet. Results obtained are as follow:

Test	Results (%)
Non-competing sub-test:	
Competing sub-test	
Comments:	

The South African Digits-in-Noise (DIN) test, with diotic and antiphasic listening conditions, will be used to evaluate the participants' ability to recognise speech in the presence of noise. Results obtained are as follow:

Test	Results
Diotic (in-phase)	
Antiphasic (out-of-phase)	
Comments:	

Summary and recommendations:

Kind regards,

Researcher

Ms. Lianca Strydom

E-mail: liancastrydom62@gmail.com

Supervisor

Prof. Lidia Pottas

E-mail: lidia.pottas@up.ac.za

Supervisor

Prof. Maggi Soer

E-mail: maggi.soer@up.ac.za

Faculty of Humanities
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Fakulteit Geesteswetenskappe
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Appendix F: Case history questionnaire

Appendix F

UNIVERSITEIT VAN PRETORIA
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Faculty of Humanities
Department of Speech-Language Pathology and Audiology

CASE HISTORY FORM TO THE RESEARCH STUDY:

Selective auditory attention and speech-in-noise perception in English second language learners

Thank you for your participation in this research study. Please answer the following questions about your child as truthfully and accurate as possible.

Section A: Demographical information

Child information	
Your child's name:	
Your child's date of birth:	YYYY / MM / DD
Your child's age:	
Your child's gender:	☐ Male ☐ Female
Your child's first language:	☐ English ☐ isiXhosa ☐ SiSwati ☐ Afrikaans ☐ isiNdebele ☐ XItsonga ☐ isiZulu ☐ Setswana ☐ Tshivenda ☐ Sepedi ☐ Sesotho Other: _____
Caregiver information	
Your name:	
Your date of birth:	YYYY / MM / DD
Your relationship to the child:	
Your cell phone number:	
Your occupation:	
Your first language:	☐ English ☐ isiXhosa ☐ SiSwati ☐ Afrikaans ☐ isiNdebele ☐ XItsonga ☐ isiZulu ☐ Setswana ☐ Tshivenda ☐ Sepedi ☐ Sesotho Other: _____

Language(s) spoken at home:	
English	
Afrikaans	
IsiNdebele	
IsiXhosa	
IsiZulu	
Sepedi	
SeSotho	
Setswana	
SiSwati	
XiTsonga	
Other, please specify:	

If your child has been exposed to English in these situations, please specify:	The age of exposure:	Approximately daily exposure (hours):
☐ Caregivers		
☐ Television		
☐ Books		
☐ Radio		
☐ When playing with friends or family members		
☐ Nursery school / day care		
☐ Grade R		
☐ Other: PLEASE SPECIFY		

Section B: Medical history

Does your child have a history of ear infections? _____

When? _____

Does your child experience difficulty to hear? _____

If yes, in which situations? _____

Has your child experienced any? _____

Trauma to the head? _____

Epileptic seizure? _____

Injury due to an accident? _____

Has your child had any ear surgery? _____

If yes, please specify: _____

Is your child on any medication? _____

If yes, please specify: _____

Section C: Academic history

Does your child experience any difficulty with the following areas in school:	YES	NO
Reading		
Writing		
Following instructions		
Spelling		
Completing tasks in time		

Does your child have any learning difficulties or Attention Deficit Hyperactivity Disorder (ADHD)? _____

If yes, please specify: _____

_____ _____

Signature Date

Appendix G: Summarised data collection record form

Appendix G

UNIVERSITEIT VAN PRETORIA
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Faculty of Humanities
Department of Speech-Language Pathology and Audiology

SUMMARISED DATA COLLECTION RECORD FORM

Name of learner:_____ Date of birth:_____

Chronological age:_____ Gender:_____

English first language speaker: ☐ **English second language speaker:** ☐

1.)

Summary of results:					
SAAT			**DIN test**		
Non-competing sub-test:	List 1: List 3:		SNR:	Diotic:	
Competing sub-test:	List 2: List 4:			Antiphasic:	
Pass / Refer			Pass / Refer		

2.)

Digits-In-Noise (DIN) test:	
Condition	**Results**
Diotic:	
Antiphasic:	

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3.)

Selective Auditory Attention test:							
List 1		**List 2**		**List 3**		**List 4**	
SCHOOL		BROOM		MOON		SPOON	
BALL		BOWL		BELL		BOW	
SMOKE		COAT		COKE		GOAT	
FLOOR		DOOR		CORN		HORN	
FOX		SOCKS		BOX		BLOCKS	
HAT		FLAG		BAG		BLACK	
PAN		FAN		CAN		MAN	
BREAD		RED		THREAD		BED	
NECK		DESK		NEST		DRESS	
STAIR		BEAR		CHAIR		PEAR	
EYE		PIE		FLY		TIE	
KNEE		TEA		KEY		BEE	
STREET		MEAT		FEET		TEETH	
WING		STRING		SPRING		RING	
MOUSE		CLOWN		CROWN		MOUTH	
SHIRT		CHURCH		DIRT		SKIRT	
GUN		THUMB		SUN		GUM	
BUS		RUG		CUP		BUG	
TRAIN		CAKE		SNAKE		PLANE	
ARM		BARN		CAR		STAR	
CHICK		STICK		DISH		FISH	
CRIB		SHIP		BIB		LIP	
WHEEL		SEAL		QUEEN		GREEN	
STRAW		DOG		SAW		FROG	
PAIL		NAIL		JAIL		TAIL	
# Correct		**# Correct**		**# Correct**		**# Correct**	
% Correct		**% Correct**		**% Correct**		**% Correct**	

Lianca Strydom *(Researcher)*

Prof. Lidia Pottas *(Supervisor)*

Prof. Maggi Soer *(Supervisor)*

Fakulteit Geesteswetenskappe
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Appendix H: COVID-19 questionnaire

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Appendix H

Faculty of Humanities
Department of Speech-Language Pathology and Audiology

COVID-19 QUESTIONNAIRE:

Selective auditory attention and speech-in-noise perception in English second language learners

Participant's name and surname: _____

	Do you have a cough?	✓ YES	✗ NO
	Do you have shortness of breath?	✓ YES	✗ NO
	Do you have a sore throat?	✓ YES	✗ NO
	Do you have a headache?	✓ YES	✗ NO
	Have you undergone COVID-19 testing?	✓ YES	✗ NO

COVID-19 	Does someone in your family have/had COVID-19?	
	✓ YES	✗ NO

TEMPERATURE:____°C

Thank you

Lianca Strydom *(Researcher)*

Prof. Lidia Pottas *(Supervisor)*

Prof. Maggi Soer *(Supervisor)*

Faculty of Humanities
Department of Speech-Language Pathology and Audiology
Fakulteit Geesteswetenskappe
Departement Spraak-Taalpatologie en Oudiologie
Lefapha la Bomotho
Kgoro ya Phatholotši ya Polelo-Maleme le Go kwa

Appendix I: Proof of submission to the International Journal of Pediatric Otorhinolaryngology

Gmail

Lianca Strydom <liancastrydom62@gmail.com>

Submission Confirmation

1 message

International Journal of Pediatric Otorhinolaryngology <em@editorialmanager.com> 25 November 2021 at 06:45
Reply-To: International Journal of Pediatric Otorhinolaryngology <support@elsevier.com>
To: Lianca Strydom <liancastrydom62@gmail.com>

Dear Lianca,

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Gmail Liancа Strydom <liancastrydom62@gmail.com>

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International Journal of Pediatric Otorhinolaryngology <em@editorialmanager.com> 25 November 2021 at 17:36
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Ms. Ref. No.: IJPORL-D-21-01323
Title: The effect of language experience on selective auditory attention and speech-in-noise perception in English second language learners
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