

**LINEAR FREQUENCY TRANSPOSITION  
AND WORD RECOGNITION ABILITIES OF  
CHILDREN WITH MODERATE-TO-SEVERE  
SENSORINEURAL HEARING LOSS**

BY  
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*“...I owe the world an attitude of gratitude.”*

*~ Clarence E Hodges*

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## **ABSTRACT**

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- TITLE**                   ▪ Linear frequency transposition and word recognition abilities of children with moderate-to-severe sensorineural hearing loss
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Conventional hearing aid circuitry is often unable to provide children with hearing loss with sufficient high frequency information in order to develop adequate oral language skills due to the risk of acoustic feedback and the narrower frequency spectrum of conventional amplification. The purpose of this study was to investigate word recognition abilities of children with moderate-to-severe hearing loss using hearing aids with linear frequency transposition. Seven children with moderate-to-severe sensorineural hearing loss between the ages of 5 years 0 months and 7 years 11 months were selected for the participant group. Word recognition assessments were first performed with the participants using their own previous generation digital signal processing hearing aids. Twenty-five-word lists from the Word Intelligibility by Picture Identification (WIPI) test were presented to the participants in three test conditions, namely: at 55 dB HL in quiet, 55 dB HL with a +5 dB signal-to-noise ratio (SNR) and at 35 dB HL. The participants were then fitted with an ISP-based hearing aid without linear frequency transposition, and the word recognition assessments were repeated with different WIPI word lists under the same conditions as the first assessment. Linear frequency transposition was then activated in the ISP-based hearing aid and different WIPI word lists were presented once more under identical conditions as the previous assessments. A 12-day acclimatization period was allowed between assessments, and all fittings were verified according to the DSL v5 fitting algorithm. Results indicated a significant increase of more than 12% in word recognition score for some of the participants when they used the ISP-based hearing aid with linear frequency transposition. A significant decrease was also seen for some of the participants when they used the

ISP-based hearing aid with linear frequency transposition, but all participants presented with better word recognition scores when they used the ISP-based hearing aids without linear frequency transposition compared to their previous generation digital signal processing hearing aids. This study has shown that linear frequency transposition may improve the word recognition skills of some children with moderate-to-severe sensorineural hearing loss, and more research is needed to explore the criteria that can be used to determine candidacy for linear frequency transposition.

*Keywords: advanced digital signal processing, audiology, children with hearing loss, developed countries, developing contexts, evidence-based practice, hearing aids, linear frequency transposition, moderate-to-severe sensorineural hearing loss, paediatric amplification, Word Intelligibility by Picture Identification (WIPI), word recognition.*

Konvensionele gehoorapparaat tegnologie is meestal nie instaat om kinders met gehoorverlies te voorsien van genoeg hoë frekwensie inligting nie. Hoë frekwensie inligting is noodsaaklik vir die normale ontwikkeling van orale spraak- en taalvaardighede, en kan beperk word as gevolg van die risiko vir akoestiese terugvoer en die kleiner frekwensie-spektrum van die gehoorapparaat. Die doel van hierdie studie was om woordherkenningsvaardighede van kinders met matig-tot-ernstige sensoriesneurale gehoorverlies wat gepas is met gehoorapparate wat liniêre frekwensie transposisie inkorporeer, te ondersoek. Sewe kinders met matig-tot-ernstige sensoriesneurale gehoorverlies tussen die ouderdomme van 5 jaar 0 maande en 7 jaar 11 maande het deelgeneem aan die studie. Woordherkenning is eers getoets met die deelnemers se eie vorige generasie digitale seinprosessering gehoorapparate. Vyf-en-twintig-woord lysie van die Woordverstaanbaarheid deur Prent Identifikasie (WPI) toets is in drie toetsituasies aan die deelnemers aangebied, naamlik: eerstens teen 55 dB HL in stilte, dan teen 55 dB met 'n sein-tot-ruis verhouding van +5 dB HL, en laastens teen 35 dB HL in stilte. Die deelnemers is daarna gepas met derde generasie digitale gehoorapparate wat gebruik maak van geïntegreerde seinprosessering (ISP), en die WPI woordlyste is herhaal onder dieselfde toestande as vantevore, maar met ander woordlyste. Liniêre frekwensie transposisie is daarna geaktiveer in die gehoorapparate, en die woordherkenningstoetse is weereens herhaal onder identiese toestande as vantevore, maar weer met ander WPI woordlyste. Tien dae is tussen die assesserings toegelaat vir akklimatisasie, en alle passings is geverifieër volgens die DSL v5 passingsformule. Resultate het aangedui dat sommige van die deelnemers 'n betekenisvolle verbetering in woordherkenning van meer as 12% getoon het wanneer hulle die ISP-gehoorapparate gebruik het met liniêre frekwensie transposisie. Sommige van die deelnemers het ook met 'n betekenisvolle verswakking in woordherkenning gepresenteer toe hulle die ISP-gehoorapparate met liniêre frekwensie transposisie gebruik het, maar alle deelnemers het beter woordherkenning met die ISP-gehoorapparate sonder liniêre frekwensie transposisie gehad in teenstelling met hulle eie vorige generasie gehoorapparate. Hierdie studie het aangedui dat liniêre frekwensie transposisie woordherkenningsvaardighede van

sommige kinders met matig-tot-ernstige sensoriesneurale gehoorverlies kan verbeter, en meer navorsing is nodig om die kriteria te ondersoek waarvolgens kandidaatskap vir liniêre frekwensie transposisie bepaal kan word.

*Sleutelwoorde: bewys-gebaseerde praktyk, gehoorapparate, gevorderde digitale seinprosessering, kinders met gehoorverlies, liniêre frekwensie transposisie, matig-tot-ernstige sensoriesneurale gehoorverlies, ontwikkelde lande, ontwikkelende kontekste, oudiologie, pediatriese versterking, woordherkenning, Woordverstaanbaarheid deur Prent Identifikasie (WPI).*

**CHAPTER 1: INTRODUCTION AND ORIENTATION**

<b>1.1</b>	<b>INTRODUCTION.....</b>	<b>▪ 1</b>
<b>1.2</b>	<b>BACKGROUND AND RATIONALE.....</b>	<b>▪ 2</b>
<b>1.3</b>	<b>RESEARCH QUESTION.....</b>	<b>▪ 10</b>
<b>1.4</b>	<b>OUTLINE OF CHAPTERS.....</b>	<b>▪ 12</b>
<b>1.5</b>	<b>DEFINITION OF TERMS.....</b>	<b>▪ 13</b>
<b>1.6</b>	<b>ACRONYMS.....</b>	<b>▪ 15</b>
<b>1.7</b>	<b>CONCLUSION.....</b>	<b>▪ 15</b>

**CHAPTER 2: CHILDREN WITH MODERATE TO SEVERE  
SENSORINEURAL HEARING LOSS**

<b>2.1</b>	<b>INTRODUCTION.....</b>	<b>▪ 17</b>
<b>2.2</b>	<b>PREVALENCE OF MSSHL IN CHILDREN.....</b>	<b>▪ 18</b>
<b>2.3</b>	<b>AETIOLOGY OF MSSHL IN CHILDREN.....</b>	<b>▪ 23</b>
	2.3.1 Genetic syndromic hearing loss.....	▪ 26
	2.3.2 Genetic non-syndromic hearing loss.....	▪ 27
	2.3.3 Non-genetic causes of MSSHL in children.....	▪ 30
<b>2.4</b>	<b>OUTCOMES OF CHILDREN WITH MSSHL.....</b>	<b>▪ 36</b>
	2.4.1 Communicative outcomes of children with MSSHL.....	▪ 42
	2.4.2 Educational outcomes of children with MSSHL.....	▪ 47
	2.4.3 Socio-emotional outcomes of children with MSSHL.....	▪ 49
<b>2.5</b>	<b>CONCLUSION.....</b>	<b>▪ 52</b>

**CHAPTER 3: THE RECOGNITION OF SPOKEN WORDS:  
A DEVELOPMENTAL PERSPECTIVE**

<b>3.1</b>	<b>INTRODUCTION.....</b>	<b>▪ 53</b>
<b>3.2</b>	<b>NORMAL DEVELOPMENT OF THE AUDITORY SYSTEM.....</b>	<b>▪ 55</b>
	3.2.1 Embryonic development and prenatal hearing.....	▪ 56
	3.2.2 Postnatal maturation of the auditory system.....	▪ 61
<b>3.3</b>	<b>THE NEUROPHYSIOLOGY OF THE AUDITORY SYSTEM AND WORD RECOGNITION.....</b>	<b>▪ 62</b>

3.3.1	The Cohort model.....	65
3.3.2	The TRACE model.....	66
3.3.3	The Shortlist model.....	67
3.3.4	The Neighbourhood Activation Model (NAM) and the Paradigmatic and Syntactic model (PARSYN).....	67
<b>3.4</b>	<b>THE EFFECT OF DEPRIVATION ON WORD RECOGNITION.....</b>	<b>68</b>
<b>3.5</b>	<b>ASSESSMENT OF WORD RECOGNITION SKILLS IN CHILDREN.....</b>	<b>71</b>
3.5.1	Paediatric open-set word recognition assessments.....	73
3.5.2	Paediatric closed-set word recognition assessments.....	74
<b>3.6</b>	<b>CONCLUSION.....</b>	<b>76</b>

**CHAPTER 4: LINEAR FREQUENCY TRANSPOSITION TECHNOLOGY  
AND CHILDREN: AN EVIDENCE-BASED PERSPECTIVE**

<b>4.1</b>	<b>INTRODUCTION.....</b>	<b>77</b>
<b>4.2</b>	<b>CONVENTIONAL ADVANCED DIGITAL SIGNAL PROCESSING SCHEMES AND CHILDREN.....</b>	<b>80</b>
4.2.1	Directional microphone technology.....	82
4.2.2	Digital noise reduction.....	83
4.2.3	Spectral speech enhancement.....	83
4.2.4	Extended high frequency amplification.....	84
<b>4.3</b>	<b>FREQUENCY LOWERING TECHNOLOGY.....</b>	<b>85</b>
4.3.1	Terminology issues.....	86
4.3.2	Early frequency lowering strategies and their implementation in hearing aids.....	87
4.3.3	Linear frequency transposition.....	90
<b>4.4</b>	<b>CONCLUSION.....</b>	<b>93</b>

**CHAPTER 5: METHOD**

<b>5.1</b>	<b>INTRODUCTION.....</b>	<b>94</b>
<b>5.2</b>	<b>AIMS OF RESEARCH.....</b>	<b>95</b>
5.2.1	Main aim.....	95
5.2.2	Sub aims.....	95
<b>5.3</b>	<b>RESEARCH DESIGN.....</b>	<b>95</b>

<b>5.4</b>	<b>SUBJECTS</b> .....	▪ 97
5.4.1	Selection criteria.....	▪ 97
5.4.2	Subject selection procedures.....	▪ 99
5.4.3	Sample size.....	▪ 99
<b>5.5</b>	<b>DATA COLLECTION</b> .....	▪ 100
5.5.1	Data collection apparatus.....	▪ 100
5.5.2	Data collection materials.....	▪ 101
<b>5.6</b>	<b>RESEARCH PROCEDURES</b> .....	▪ 101
5.6.1	Data collection procedures.....	▪ 101
5.6.1.1	<i>Phases 1 and 2: Assessments with previous generation digital signal processing hearing aids</i> .....	▪ 104
5.6.1.2	<i>Phase 3: Third assessment with previous generation digital signal processing hearing aids</i> .....	▪ 106
5.6.1.3	<i>Phase 4: Acclimatisation period</i> .....	▪ 107
5.6.1.4	<i>Phase 5: Assessments with ISP-based hearing aids without linear frequency transposition</i> .....	▪ 107
5.6.1.5	<i>Phase 6: Acclimatisation period</i> .....	▪ 108
5.6.1.6	<i>Phase 7: Assessments with ISP-based hearing aids with linear frequency transposition</i> .....	▪ 108
5.6.2	Procedures for data recording and analysis.....	▪ 108
5.6.2.1	<i>Recording of data</i> .....	▪ 108
5.6.2.2	<i>Procedures for analysis of data</i> .....	▪ 108
<b>5.7</b>	<b>ETHICAL CONSIDERATIONS</b> .....	▪ 109
5.7.1	Autonomy.....	▪ 109
5.7.2	Beneficence.....	▪ 110
5.7.3	Justice.....	▪ 111
<b>5.8</b>	<b>RELIABILITY AND VALIDITY</b> .....	▪ 111
<b>5.9</b>	<b>CONCLUSION</b> .....	▪ 114

## **CHAPTER 6: RESULTS AND DISCUSSION**

<b>6.1</b>	<b>DISCUSSION OF RESULTS</b> .....	▪ 115
6.1.1	Description of the subjects.....	▪ 115

6.1.2	Word recognition scores of children using previous generation digital signal processing hearing aids.....	▪ 118
6.1.3	Word recognition scores of children using ISP-based hearing aids without linear frequency transposition.....	▪ 127
6.1.4	Word recognition scores of children using ISP-based hearing aids with linear frequency transposition.....	▪ 134
6.1.5	A comparison of the word recognition scores obtained by the subjects using ISP-based hearing aids with and without linear frequency transposition.....	▪ 139
<b>6.2</b>	<b>CONCLUSION.....</b>	<b>▪ 146</b>

## **CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS**

<b>7.1</b>	<b>INTRODUCTION.....</b>	<b>▪ 148</b>
<b>7.2</b>	<b>CONCLUSIONS.....</b>	<b>▪ 149</b>
7.2.1	Word recognition skills of children using previous generation digital signal processing hearing aids.....	▪ 149
7.2.2	Word recognition scores of children using ISP-based hearing aids without linear frequency transposition compared to previous digital signal processing hearing aids.....	▪ 151
7.2.3	Word recognition scores of children using ISP-based hearing aids with linear frequency transposition and compared to ISP-based hearing aids without linear frequency transposition.....	▪ 152
<b>7.3</b>	<b>CLINICAL IMPLICATIONS.....</b>	<b>▪ 154</b>
<b>7.4</b>	<b>CRITICAL EVALUATION OF THE STUDY.....</b>	<b>▪ 155</b>
<b>7.5</b>	<b>RECOMMENDATIONS FOR FUTURE RESEARCH.....</b>	<b>▪ 157</b>
<b>7.6</b>	<b>CLOSING STATEMENT.....</b>	<b>▪ 158</b>
	<b>REFERENCES.....</b>	<b>▪ 159</b>
	<b>APPENDICES.....</b>	<b>▪ 193</b>

## **LIST OF TABLES**

---

### **CHAPTER 1: INTRODUCTION AND ORIENTATION**

<b>Table 1</b>	Frequency lowering circuitries available at present.....	▪ 8
----------------	--	-----

### **CHAPTER 2: CHILDREN WITH MODERATE TO SEVERE SENSORINEURAL HEARING LOSS**

<b>Table 1</b>	Prevalence data for children with moderate to severe hearing loss.....	▪ 19
<b>Table 2</b>	The number of countries in the developing world.....	▪ 20
<b>Table 3</b>	Prevalence data of moderate to severe hearing loss in developing countries.....	▪ 22
<b>Table 4</b>	Estimated number of children (1000s) 0-19 years of age with MSSHL.....	▪ 22
<b>Table 5</b>	The number of loci of causal genes.....	▪ 27
<b>Table 6</b>	The genes and their loci responsible for prelingual MSSHL in children.....	▪ 28
<b>Table 7</b>	The genes and their loci responsible for postlingual MSSHL in children.....	▪ 28
<b>Table 8</b>	Prevalence of pre-, peri- and postnatal factors.....	▪ 31
<b>Table 9</b>	Basic requirements of circuitry-signal processing.....	▪ 40

### **CHAPTER 4: LINEAR FREQUENCY TRANSPOSITION TECHNOLOGY AND CHILDREN: AN EVIDENCE-BASED PERSPECTIVE**

<b>Table 1</b>	Early frequency lowering circuitries.....	▪ 87
<b>Table 2</b>	Case studies related to the use of the AE in children and adolescents.....	▪ 91

### **CHAPTER 5: METHOD**

<b>Table 1</b>	Subject group selection criteria.....	▪ 98
<b>Table 2</b>	Assessment schedule for the subject groups.....	▪ 103
<b>Table 3</b>	The components of autonomy relevant to this study.....	▪ 110
<b>Table 4</b>	Beneficence as a relative ethical principle for this study.....	▪ 111

<b>Table 5</b>	The three types of reliability in quantitative research methods.....	▪ 112
<b>Table 6</b>	The controlling of extraneous variables in this study.....	▪ 113

### ***CHAPTER 6: RESULTS AND DISCUSSION***

<b>Table 1</b>	Characteristics of the subjects (n=7).....	▪ 116
<b>Table 2</b>	A summary of the subjects' own previous generation digital signal processing hearing aids.....	▪ 118
<b>Table 3</b>	The SII calculated for soft and average speech sounds.....	▪ 120
<b>Table 4</b>	Word recognition scores of subjects using previous generation digital signal processing hearing aids (n=7).....	▪ 123
<b>Table 5</b>	Features of the ISP-based hearing aids.....	▪ 128
<b>Table 6</b>	The SII for soft and average input levels for the ISP-based hearing aids.....	▪ 129
<b>Table 7</b>	Word recognition scores of subjects using ISP-based hearing aids without linear frequency transposition (n=7).....	▪ 131
<b>Table 8</b>	The linear frequency transposition start frequencies for each subject.....	▪ 135
<b>Table 9</b>	Word recognition scores of subjects using ISP-based hearing aids with linear frequency transposition.....	▪ 137

## **LIST OF FIGURES**

---

### **CHAPTER 2: CHILDREN WITH MODERATE TO SEVERE SENSORINEURAL HEARING LOSS**

<b>Figure 1</b>	Aetiology of MSSHL.....	▪ 25
<b>Figure 2</b>	Variables related to the outcomes of children with MSSHL.....	▪ 36
<b>Figure 3</b>	The distribution of race in the South African population.....	▪ 37
<b>Figure 4</b>	The percentage of people using each of the eleven official languages at home.....	▪ 37

### **CHAPTER 3: THE RECOGNITION OF SPOKEN WORDS: A DEVELOPMENTAL APPROACH**

<b>Figure 1</b>	Audibility of the different speech sounds in the presence of MSSHL.....	▪ 70
-----------------	--	------

### **CHAPTER 4: LINEAR FREQUENCY TRANSPOSITION TECHNOLOGY AND CHILDREN: AN EVIDENCE-BASED PERSPECTIVE**

<b>Figure 1</b>	Levels of evidence produced by clinical research.....	▪ 79
<b>Figure 2</b>	Grades of recommendation.....	▪ 79
<b>Figure 3</b>	A spectrogram of the word “monkeys” as spoken by a female talker.....	▪ 84
<b>Figure 4</b>	The extra speech cues provided by linear frequency transposition for the speech sound /s/.....	▪ 92

### **CHAPTER 5: METHOD**

<b>Figure 1</b>	An overview of the research phases.....	▪ 102
-----------------	---	-------

### **CHAPTER 6: RESULTS AND DISCUSSION**

<b>Figure 1</b>	Discussion of the results according to the sub aims.....	▪ 115
<b>Figure 2</b>	Child A: aided thresholds.....	▪ 121
<b>Figure 3</b>	Child B: aided thresholds.....	▪ 121
<b>Figure 4</b>	Child C: aided thresholds.....	▪ 121

<b>Figure 5</b>	Child D: aided thresholds.....	▪ 121
<b>Figure 6</b>	Child E: aided thresholds.....	▪ 121
<b>Figure 7</b>	Child F: aided thresholds.....	▪ 121
<b>Figure 8</b>	Child G: aided thresholds.....	▪ 121
<b>Figure 9</b>	The difference between the test scores obtained for the first, second and third test conditions.....	▪ 125
<b>Figure 10</b>	A comparison of the SII for soft speech levels and the word recognition scores obtained.....	▪ 126
<b>Figure 11</b>	Child A: aided thresholds.....	▪ 130
<b>Figure 12</b>	Child B: aided thresholds.....	▪ 130
<b>Figure 13</b>	Child C: aided thresholds.....	▪ 130
<b>Figure 14</b>	Child D: aided thresholds.....	▪ 130
<b>Figure 15</b>	Child E: aided thresholds.....	▪ 130
<b>Figure 16</b>	Child F: aided thresholds.....	▪ 130
<b>Figure 17</b>	Child G: aided thresholds.....	▪ 130
<b>Figure 18</b>	A comparison between word recognition scores of subjects across all the test conditions.....	▪ 133
<b>Figure 19</b>	A comparison of the SII calculated for soft speech input (55 dB SPL) and word recognition scores obtained at 35 dB HL.....	▪ 133
<b>Figure 20</b>	Child A: aided thresholds.....	▪ 136
<b>Figure 21</b>	Child B: aided thresholds.....	▪ 136
<b>Figure 22</b>	Child C: aided thresholds.....	▪ 136
<b>Figure 23</b>	Child D: aided thresholds.....	▪ 136
<b>Figure 24</b>	Child E: aided thresholds.....	▪ 136
<b>Figure 25</b>	Child F: aided thresholds.....	▪ 136
<b>Figure 26</b>	Child G: aided thresholds.....	▪ 136
<b>Figure 27</b>	A comparison of word recognition scores when using an ISP-based hearing aid with linear frequency transposition.....	▪ 138
<b>Figure 28</b>	A comparison of word recognition scores obtained during the first test condition.....	▪ 139
<b>Figure 29</b>	A comparison of the average word recognition scores obtained during the first test condition.....	▪ 140

<b>Figure 30</b>	A comparison of word recognition scores obtained during the second test condition.....	▪ 141
<b>Figure 31</b>	A comparison of the average word recognition scores obtained during the second test condition.....	▪ 142
<b>Figure 32</b>	A comparison of word recognition scores obtained during the third test condition.....	▪ 142
<b>Figure 33</b>	A comparison of the average word recognition scores obtained during the third test condition.....	▪ 143
<b>Figure 34</b>	The number of subjects presenting with acceptable word recognition scores for the first test condition.....	▪ 144
<b>Figure 35</b>	The number of subjects presenting with acceptable word recognition scores for the second test condition.....	▪ 145