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

BY
ANNERINA GROBBELAAR

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PROMOTER: Dr Catherine van Dijk
CO-PROMOTER: Mrs Emily Groenewald

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“...I owe the world an attitude of gratitude.”
~ Clarence E Hodges

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ABSTRACT

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.
OPSOMMING

Konvensionele gehoorapparaat tegnologie is meestal nie instaat om kinders met gehoorverlies te voorsien van genoeg hoë frekwensie inligting nie. Hoë frekwensie inligting is noodskaaklik 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 gegaap is met gehoorapparate wat linière frekwensie transposisie inkorporeer, te onderzoek. 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 lyste van die Woordverstaanbaarheid deur Prent Identifikasie (WPI) toets is in drie toetssituasies 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 gegaap 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. Linière frekwensie transposisie is daarna gegaakte in die gehoorapparate, en die woordherkenningstoetse is weereens herhaal onder identieke toestande as vantevore, maar weer met ander WPI woordlyste. Tien dae is tussen die asseserings toegelaat vir akklimatisasie, en alle passings is geverifieer 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 linière frekwensie transposisie. Sommige van die deelnemers het ook met ‘n betekenisvolle verswakking in woordherkenning gepresenteer toe hulle die ISP-gehoorapparate met linière frekwensie transposisie gebruik het, maar alle deelnemers het beter woordherkenning met die ISP-gehoorapparate sonder linière frekwensie transposisie gehad in teenstelling met hulle eie vorige generasie gehoorapparate. Hierdie studie het aangedui dat linière 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 linière frekwensie transposisie bepaal kan word.

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