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**SPEECH MOTOR DEVELOPMENT
OF AFRIKAANS SPEAKING
CHILDREN
AGED FOUR TO SEVEN YEARS**

By

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Presented in partial fulfillment of the requirements for the
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"I will praise you, O Lord, among the nations; I will sing of you among the peoples. For great is your love, reaching to the heavens; your faithfulness reaches to the skies. Be exalted O God, above the heavens; let your glory be all over the earth." (Ps.57:9-11)

SUMMARY

SPEECH MOTOR DEVELOPMENT OF AFRIKAANS SPEAKING CHILDREN AGED FOUR TO SEVEN YEARS

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The limited amount of normative information regarding speech motor development in the clinically important age range four to seven years served as motivation for this study. The main aim of the study was to collect normative information regarding sensorimotor speech control skills of pre-school children.

The method of the study was designed and the results interpreted within the framework of the four-level model of speech production of Van der Merwe (1997). Basic qualitative and quantitative data were gathered for a variety of aspects of speech motor development in Afrikaans-speaking children aged 4;0 to 6;7 years in the following areas: 1) non-speech oral movements, 2) non-speech diadochokinesis, 3) speech diadochokinesis, 4) cluster production, 5) word syllable structure in spontaneous speech, 6) acoustic data regarding first-vowel duration and variability of first-vowel duration in repeated utterances of the same word, 7) acoustic voice onset time data, 8) acoustic data regarding first-syllable duration in words of increasing length.

Results indicated that associated movements and accuracy errors occurred in some non-speech oral movement and non-speech diadochokinesis tasks.

Normative, diadochokinetic rate data were gathered. Perceptual analysis indicated difficulty with glottal and three-place diadochokinesis tasks. Subjects produced 84% of initial clusters in isolation correctly and 79% of final clusters. Schwa-vowel insertions occurred in clusters in isolation, but not in spontaneously produced words. Subjects produced 163 different word syllable structures in spontaneous speech, with 18 structures occurring in all subjects' data. Six-year-olds generally displayed the shortest first-vowel duration. Individual, non-age related trends occurred for variability of first-vowel duration. Mean voice onset times in voiced stop contexts ranged from -97ms to +12ms, with overall instances of mean voicing lead occurring in 27% of the four-year-olds' productions, 4% of the five-year-olds' productions and 80% of the six-year-olds' productions. Mean voice onset times in voiceless stop contexts ranged from +11ms to +37ms. Subjects adapted first-syllable duration to word length by decreasing it as the word length increased.

Results indicated that a wide range of normal speech motor performance is possible for children this age, and that individuals can display different performance levels for different speech parameters. This emphasizes the complexity of speech motor development and the need to assess a variety of speech motor parameters. It is essential that quantitative (objective) analysis of children's speech motor performance be supplemented with qualitative (descriptive) analysis. The study contributed knowledge to the understanding of certain aspects of speech motor development and to the speech production process in general.

Key words: sensorimotor speech control, speech motor development, non-speech oral movements, non-speech diadochokinesis, speech diadochokinesis, cluster production, word syllable structure, vowel duration, variability of vowel duration, voice onset time, first-syllable duration in words of increasing length

SAMEVATTING

SPRAAKMOTORIESE ONTWIKKELING VAN VIER- TOT SEWEJARIGE AFRIKAANSSPREKENDE KINDERS

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Die beperkte mate van normatiewe spraakmotoriese inligting vir kinders in die belangrike kliniese ouerdomsinterval vier to sewe jaar, het as motivering vir hierdie studie gedien. Die hoofdoel van die studie was die versameling van normatiewe inligting rakende sensories-motoriese spraakvaardighede van voorskoolse kinders.

Die metode van die studie is beplan en die resultate geïnterpreteer binne die raamwerk van die vier-vlak model van spraakproduksie deur Van der Merwe (1997). Basiese kwalitatiewe en kwantitatiewe data is versamel vir 'n verskeidenheid van spraakmotoriese aspekte in normale, 4;0 tot 6;7-jarige Afrikaanssprekende kinders in die volgende areas: 1) nie-spraak orale bewegings, 2) nie-spraak diadokokinese, 3) spraak-diadokokinese, 4) produksie van klankkombinasies, 5) woordlettergreepstruktuur in spontane spraak, 6) akoestiese data rakende duur van die eerste vokaal en variasie daarvan in herhaalde uitinge, 7) akoestiese stemaanvangstyddata, 8) akoestiese data rakende die duur van die eerste lettergreep in woorde van toenemende lengte.



Geassosieerde bewegings en akkuraatheidsfoute het voorgekom in sommige nie-spraak orale bewegingstake en nie-spraak diadokokinesetake. Diadokokinesespoed-inligting is versamel. Perseptuale analise het probleme met veral glottale en drie-plek diadokokinese geïdentifiseer. Proefpersone het 84% van inisiële klankkombinasies korrek geproduseer en 79% van finale klankkombinasies. Schwa-vokaalinvoegings het voorgekom in produksies van klankkombinasies in isolasie maar nie in spontane spraak nie. 'n Verskeidenheid van 163 woordlettergreepstrukture is geproduseer, waarvan 18 in al die proefpersone se data voorgekom het. Sesjarige het die kortste eerste-vokaalduur vertoon. Individuele, nie-ouderdomsverwante tendense was teenwoordig vir variasie van eerste-vokaalduur. Gemiddelde stemaanvangstydwaardes vir stemhebbende afsluitingsklankkontekste het gestrek vanaf -97ms tot $+12\text{ms}$. Vierjarige het stemvoorloop vertoon in 27% van hulle gemiddelde stemaanvangstydwaardes vir stemhebbende afsluitingsklanke, teenoor vyfjarige se 4% en sesjarige se 80%. Gemiddelde stemaanvangstydwaardes vir stemlose afsluitingsklanke het gestrek vanaf $+11\text{ms}$ tot $+37\text{ms}$. Proefpersone het die duur van die eerste lettergreep aangepas by toenemende woordlengte deur duur te verminder soos wat die woord verleng.

Die bevindinge van die studie dui daarop dat 'n wye omvang van normale spraakmotoriese gedrag kan voorkom by kinders van hierdie ouderdom en dat individue verskillende prestasievlakke kan toon vir verskillende spraakparameters. Resultate beklemtoon die kompleksiteit van spraakmotoriese ontwikkeling en die belang daarvan om 'n verskeidenheid van parameters te evalueer. Dit is essensieël dat kwantitatiewe (objektiewe) analise van kinders se spraakmotoriese gedrag aangevul word met kwalitatiewe (beskrywende) analise. Hierdie studie dra by tot die begrip van sekere aspekte van spraakmotoriese ontwikkeling en spraakproduksie in die algemeen.

Sleuteltermes: sensories-motoriese spraakvaardighede, spraakmotoriese ontwikkeling, nie-spraak orale bewegings, nie-spraak diadokokinese, spraakdiadokokinese, produksie van klankkombinasies, woordlettergreepstruktuur, vokaalduur, stemaanvangstyd, eerste-lettergreepduur in woorde van toenemende lengte.

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LIST OF ABBREVIATIONS

2S-OM:	Two-sequence oral movements
3S-OM:	Three-sequence oral movements
ARW:	Afrikaanse Reseptiewe Woordeskattoets
C:	Consonant
cm:	Centimeters
CPG:	Central pattern generator
CfV:	Coefficient of variation
DAS:	Developmental apraxia of speech
dB:	Decibel
DDK:	Diadochokinesis
DDR:	Diadochokinetic rate
DSD:	Developmental speech disorders
DSP:	Digital signal processor
DPD:	Developmental phonological disorders
DVD:	Developmental verbal dyspraxia
EMG:	Electromyogram
EMMA:	Electro-magnetic midsagittal articulometer
EP:	Error percentage
F:	Formant
FCL:	Final consonant clusters
FSD:	First-syllable duration
FVD:	First-vowel duration
GDDK:	Glottal diadochokinesis
Hz:	Hertz
ICL:	Initial consonant clusters
I-OM:	Isolated oral movements
LDDK:	Lip diadochokinesis
LPC:	Linear predictive coding
Max.:	Maximum
Min.:	Minimum
ms:	Milliseconds



LIST OF ABBREVIATIONS

(CONTINUED)

n:	Number
NSO-DDK:	Non-speech oral diadochokinesis
NSOM:	Non-speech oral movements
PC:	Percentage correct
POO:	Percentage of occurrence
rep/sec:	Repetitions per second
S:	Subject
SD:	Standard deviation
S-DDK:	Speech diadochokinesis
sec:	Second
STDEV:	Standard deviation
TFS:	Total functional score
TDDK:	Tongue diadochokinesis
TM:	Target movement
V:	Vowel
VDDK:	Velar diadochokinesis
VOT:	Voice onset time
Wg:	Word group
yrs:	Years