

**TEMPORAL ASPECTS OF SPEECH PRODUCTION IN  
BILINGUAL SPEAKERS WITH NEUROGENIC SPEECH  
DISORDERS**

by

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***“For the Lord gives wisdom, and from his mouth come knowledge and understanding.” Proverbs 2:6***

Dedicated to the persons with communication disorders with whom I have had the privilege to work... You have enriched my life beyond words!

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*“The primary intellectual aim of the humanities and social inquiry, quite generally, is to help us to realize what is of value to us in our personal and social lives. What ultimately matters is personal and social progress towards enlightenment and wisdom: all academic progress is but a means to this end.” (Maxwell, 1984:73)*

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## SUMMARY

<b>TITLE</b>	Temporal aspects of speech production in bilingual speakers with neurogenic speech disorders
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The present study is the first to examine the effect of first versus second language (L1 versus L2) speech production on specific temporal parameters of speech in bilingual speakers with neurogenic speech disorders. Three persons with apraxia of speech (AOS), three with phonemic paraphasia (PP) and five normal speaking participants were included as subjects in the study. Subjects were required to read phonemically similar L1 and L2 target utterances in a carrier phrase, five times each, at a normal and fast speaking rate, respectively. This rendered four speaking contexts that included speech production in L1 at either a normal (L1NR) or fast speaking rate (L1FR) and speech production in L2 at either a normal (L2NR) or fast speaking rate (L2FR). Acoustic analysis of on-target productions involved measurement of utterance onset duration, vowel duration, utterance duration and voice onset time.

Results revealed that in normal speakers, speech production in L2 results in greater token-to-token variability than in L1. However, token-to-token variability in the experimental subjects did not tend to increase whilst speaking in L2, most probably because these subjects generally decreased their speaking rate in this context, resulting in more consistent production. The subjects with AOS and PP seemed to be influenced by the increased processing demands of speaking in L2 to a greater extent than the normal speakers, in that they more frequently experienced difficulty with durational adjustments (decreasing duration in the fast speaking rate) in L2 than in L1. Furthermore, the subjects with AOS or PP also exhibited a greater extent of durational adjustment in L1 than in L2. The durations of most of the subjects with either AOS or PP tended to differ from those of the normal group to a greater extent in L2FR that was hypothesized to be the most demanding speaking context for these subjects.

The longer than normal durations and greater than normal token-to-token variability in the subjects with either AOS or PP imply the presence of a motor control deficit. The extent of the motor control deficit appears to be more severe in AOS than in PP as is evident from the finding that the subjects with AOS generally exhibited longer durations and greater token-to-token variability than the subjects with PP. The pattern of breakdown in respect of different parameters and utterance groups also differed between subjects with AOS and PP. The nature of the disorder in AOS and PP thus appears to be both quantitatively and qualitatively different. Regarding measurement of the different temporal parameters, voice onset time appears to be less subject to the influence of L2 than the other measured temporal parameters.

The results of this study imply that bilingual AOS is as much a reality as bilingual aphasia. Furthermore, the results underscore the importance of taking contextual factors, specifically L1 versus L2, into account when compiling assessment and treatment procedures for persons with either AOS or PP, since speech production in L2 appears to be motorically more difficult than in L1 for persons with neurogenic involvement. The significance of the results is discussed with reference to the influence of speech production in L2 on temporal control and the underlying nature of AOS and PP with regard to theories of speech sensorimotor control.

**Key words:** speech motor control, speech production, speech and language processing, motor planning, linguistic-symbolic planning, processing demands, apraxia of speech, phonemic paraphasia, temporal parameters, temporal control, token-to-token variability, acoustic analysis, vowel duration, utterance duration, utterance onset duration, voice onset time, contextual factors

## OPSOMMING

<b>TITEL</b>	Temporale aspekte van spraakproduksie in tweetalige sprekers met neurogene spraakafwykings
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Hierdie studie is die eerste om die effek van eerste- teenoor tweede taal spraakproduksie op spesifieke temporale parameters van spraak in tweetalige sprekers met neurogene spraakafwykings te ondersoek. Drie persone met verbale apraksie, drie met fonemiese parafasie en vyf normaalsprekendes het as proefpersone aan die studie deelgeneem. Persone moes uitings wat fonemies dieselfde is in hul eerste en tweede taal vyf keer elk lees, teen beide 'n normale en 'n vinnige spraakspoed. Hierdie prosedure het vier kontekste vir spraakproduksie tot gevolg gehad, naamlik eerste taal in 'n vinnige en normale spoed konteks en tweede taal in 'n vinnige en normale spoed konteks. Akoestiese analise van akkurate produksies het meting van uitingaanvangsduur, vokaalduur, uitingduur en stemaanvangstyd behels.

Resultate het daarop gedui dat tweede taal spraakproduksie in normale sprekers aanleiding gee tot groter temporale veranderlikheid t.o.v. die duurmetings. Uit die resultate het dit geblyk dat persone met verbale apraksie of fonemiese parafasie tot 'n groter mate beïnvloed is deur die verhoogde prosesseringseise wat deur spraakproduksie in hul tweede taal gestel is, deurdat hulle meer dikwels probleme ervaar het met duuraanpassings (vermindering van duur in die vinnige spoed konteks) in hul tweede taal as in hul eerste taal. Verder het die persone met verbale apraksie of fonemiese parafasie ook 'n groter mate van duuraanpassing gemaak in hul eerste taal as in hul tweede taal. Die duur van meeste van die persone met verbale apraksie of fonemiese parafasie het verder die meeste van dié van die normale sprekers verskil tydens produksie teen 'n vinnige spoed in die tweede taal wat voorspel is om die

moeilikste konteks vir produksie te wees vir persone met 'n spraak- en/of taalafwyking.

Langer as normale duur en meer as normale temporale veranderlikheid in die persone met verbale apraksie of fonemiese parafasie impliseer dat 'n motoriese komponent moontlik bydra to die spraakprobleme van hierdie sprekers. Die graad van die motoriese afwyking blyk meer uitgesproke te wees in persone met verbale apraksie as in die met fonemiese parafasie, aangesien die persone met verbale apraksie meestal langer duur en meer veranderlikheid van duurmetings getoon het in vergelyking met die persone met fonemiese parafasie. Die patroon van afbraak in terme van die verskillende parameters en uitings waarmee probleme ondervind is tydens produksie het ook verskil tussen die persone met verbale apraksie en fonemiese parafasie. Die aard van die afwyking in verbale apraksie en fonemiese parafasie blyk dus kwantitatief en kwalitatief te verskil. Met betrekking tot aantasting van die verskillende parameters, het die resultate daarop gedui dat stemaanvangstyd tot 'n mindere mate aangetas is deur spraakproduksie in die tweede taal.

Die resultate van hierdie studie beklemtoon die belang daarvan om kontekstuele faktore, spesifiek eerste teenoor tweede taal spraakproduksie, in ag te neem tydens die evaluering en behandeling van tweetalige persone met verbale apraksie of fonemiese parafasie. Spraakproduksie in die tweede taal van 'n spreker blyk motories meer kompleks te wees as spraakproduksie in die eerste taal vir persone met neurogene spraak- en/of taalafwykings. Die belang van hierdie resultate word bespreek met verwysing na die invloed van tweede taal spraakproduksie op temporale kontrole van spraak en die onderliggende aard van verbale apraksie en fonemiese parafasie soos verklaar deur teorieë oor spraakproduksie.

**Slutelwoorde:** motoriese kontrole van spraak, spraakproduksie, spraak- en taalprosessering, motoriese beplanning, linguisties-simboliese beplanning, presesserings eise, verbale apraksie, fonemiese parafasie, temporale parameters, temporale kontrole, temporale veranderlikheid, akoestiese analise, vokaalduur, uitingduur, uitingaanvangsduur, stemaanvangstyd, kontekstuele faktore



## LIST OF ABBREVIATIONS

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AOS	Apraxia of speech
CA	Conduction aphasia
CSL	Computerized Speech Laboratory
CV	Consonant-vowel
FR	Fast speaking rate
GMP	Generalized motor program
GMPs	Generalized motor programs
IAS	Interarticulatory synchronization
L1	First language
L2	Second language
ms	Milliseconds
N	Normal speaking subject
NGR	Normal group
NR	Normal speaking rate
PP/(s)	Phonemic paraphasia/(s)
SD/(s)	Standard deviation/(s)
UD	Utterance duration
UOD/(s)	Utterance onset duration/(s)
VD	Vowel duration
VOT/(s)	Voice onset time/(s)
WAB	Western Aphasia Battery

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