CHAPTER FIVE
RESULTS OF THE STUDY

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5.1 INTRODUCTION

In this chapter, the results of the study are presented in relation to the experimental sub-aims. The results utilize descriptive statistics to explore temporal parameters of speech production in persons with normal speech and persons with either AOS or PP, across four contexts, namely Afrikaans at a normal speaking rate (L1NR), Afrikaans at a fast speaking rate (L1FR), English at a normal speaking rate (L2NR) and English at a fast speaking rate (L2FR). The study of temporal parameters of speech across the four contexts of speech production is undertaken in an attempt to realize the main aim of the study, namely to determine if speech production in L2 influences the temporal parameters of speech in persons with AOS. Persons with normal speech were included to serve as a comparison group, as well as persons with PP, to allow for comparison of the results with those of persons with AOS.

The results for each temporal parameter, namely, UOD, VD, UD and VOT, will be discussed separately according to each formulated sub-aim. For each temporal parameter, the data for each of the three utterance groups, namely, utterances beginning with a voiceless plosive, voiced plosive or voiceless fricative will be discussed first. *Utterance group* results involve the pooled results of all the utterances in a specific utterance group. This will be followed by a discussion of the individual utterances in each utterance group. The latter involves the mean data for the five repetitions of each utterance in a group. *Individual utterances* thus refer to the mean data for each different target utterance. The reason for reporting the results for individual utterances in addition to utterance group results is that the data for utterances as a group sometimes masked findings which were evident for most of the utterances in an utterance group. The results for a particular utterance in a group would thus have dominated the utterance group results, if its results were very different from those of the other utterances in the group. The means and SDs for the

five repetitions of each utterance for each person, utterance and context, which were used for data processing for the three sub-aims, are included in Appendix B.

5.2 SUB-AIM ONE: DETERMINATION OF THE EXTENT OF DURATIONAL ADJUSTMENT IN THE FAST RATE COMPARED TO THE NORMAL RATE IN L1 VERSUS L2

For normal speakers, it was hypothesized that the duration of the measured temporal parameter (VD, UD, UOD or VOT) would decrease in the FR compared to the NR due to the fact that the person is producing utterances faster than at a usual self-selected speaking rate. Furthermore, regarding an increase in speaking rate in L1 compared to L2, it was predicted that a speaker would be able to decrease duration, in other words, increase speaking rate, to a greater extent in the language which is more automatized when increased demands are imposed on the speech production mechanism. In the present study, increased demands were imposed by an increase in speaking rate and speaking in L2.

To determine if speaking in L2 affected the temporal parameters of speech production, the following questions were posed to address sub-aim one:

a. Was the extent of durational adjustment in the FR compared to the NR greater in L1 than in L2?
b. Could duration be decreased in the FR compared to the NR in L1 and L2 respectively? From this it could be determined if there were more instances in L2 than L1 where duration could not be decreased in the FR compared to the NR. If this were indeed the case, it could be deduced that durational adjustments in L1 were accomplished to a greater extent under conditions of increased demands on the speech production mechanism. It was predicted that this phenomenon would not necessarily be evident in normal speakers, but rather in persons with compromised speech production mechanisms.

As discussed in chapter four, the duration in the FR was expressed as a percentage of the duration in the NR to determine the extent of durational adjustment in the FR compared to the NR. A positive percentage value, of for example 16%, indicates that

the duration in the FR is 16% of the duration in the NR and a durational adjustment of 16% relative to the NR was thus made in the FR condition. A negative percentage value indicates that the duration in the FR was in fact longer than the duration in the NR and that an appropriate durational adjustment (decrease in duration) in the FR could thus not be made. The processed data for sub-aim one, expressing the duration in the FR as a percentage of the duration in the NR for each temporal parameter, utterance and utterance group across the four contexts, for each speaker and the normal group (NGR), are displayed in Appendix C.

5.2.1 Determination of the extent of durational adjustment in L1 versus L2 for *vowel duration*

Vowel duration was measured for utterances beginning with a voiceless plosive, voiced plosive and voiceless fricative.

5.2.1.1 Determination of the extent of durational adjustment in L1 versus L2 for *vowel duration* of utterances beginning with a *voiceless plosive*: Results for *utterances as a group*

In Figure 5.1, the VD in the FR is expressed as a percentage of the VD in the NR for each subject in L1 and L2 respectively.

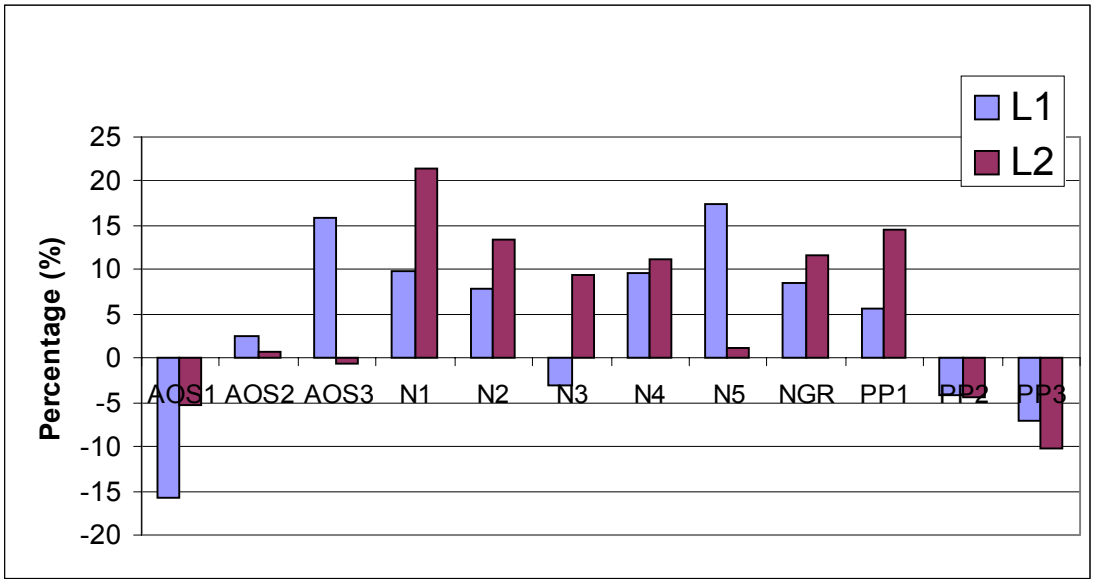

Figure 5.1 VD in FR expressed as a percentage of VD in NR indicating the extent of durational adjustment in the FR compared to the NR in L1 and L2 for utterances beginning with a voiceless plosive as a group

Regarding extent of durational adjustment in L1 compared to L2, the results indicate that all the speakers in the normal group, with the exception of N5, exhibited a greater extent of durational adjustment in the FR compared to the NR in L2. Consequently, as a group, the normal speakers had a greater extent of durational adjustment in the FR compared to the NR in L2 (11.7% in L2 compared to 8.5% in L1). PP1 also exhibited a greater extent of durational adjustment in the FR compared to the NR in L2. In contrast to this result, both AOS2 and AOS3 exhibited a greater extent of durational adjustment in L1. Subjects AOS1, PP2 and PP3 were not able to obtain a shorter duration in the FR compared to the NR in either L1 or L2. Consequently comments regarding the extent of durational adjustment in L1 compared to L2 cannot be made for these subjects. Of the normal group, only N3 did not succeed in obtaining a shorter duration in the FR compared to the NR and this occurred in L1 only.

The findings relevant to answering the questions posed to address sub-aim one are summarized in Table 5.1. In this table it is indicated if durational adjustment (decrease of duration in the FR compared to the NR) was unsuccessful for L1 and L2, respectively. It is also indicated if durational adjustment was unsuccessful in L2 only. Furthermore, it is indicated if the extent of durational adjustment was greater in L1 than in L2. If duration could not be decreased in the FR in either L1 or L1, "not applicable" was indicated, since it is not relevant to comment on the extent of durational adjustment in L1 compared to L2 if this had not been successfully achieved in either language.

Table 5.1 Findings related to the achievement of durational adjustments in L1 and L2 regarding VD of utterances beginning with a voiceless plosive as a group

	Durational adjustment was unsuccessful		Extent of durational adjustment in L1 is greater than in L2	Durational adjustment was only unsuccessful in L2
	L1	L2		
AOS1	X	X	n.a.	
AOS2			X	
AOS3		X	X	X
N1				
N2				
N3	X			
N4				
N5			X	
NGR				
PP1				
PP2	X	X	n.a.	
PP3	X	X	n.a.	

X indicates that the named behavior occurred.

5.2.1.2 Determination of the extent of durational adjustment in L1 versus L2 for *vowel duration* of utterances beginning with a *voiceless plosive*: Results for *individual utterances*

The results for each of the five utterances beginning with a voiceless plosive were viewed separately to determine the number of utterances in which the behaviors relevant to the questions posed for sub-aim one occurred. The findings relevant to these questions for utterances beginning with a voiceless plosive are indicated in Table 5.2. Specifically, it is indicated for each utterance if the extent of durational adjustment was greater in L1 than in L2. Furthermore, it is indicated if durational adjustment was unsuccessful for more L2 utterances compared to L1 utterances. Lastly, it is indicated if more than half of the utterances exhibited a greater extent of durational adjustment in L1 than in L2.

Table 5.2 Findings related to the achievement of durational adjustments in L1 and L2 regarding VD of individual utterances beginning with a voiceless plosive

	puck/"pak"	pet/"pet"	pit/"pit"	putt/"pad"	pup/"pap"	Durational adjustment was unsuccessful for more L2 utterances than L1 utterances	More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2*
	The extent of durational adjustment for the utterance was greater in L1 than L2						
AOS1							
AOS2	X	X				X	
AOS3	X	X	X	X	X	X	X
N1							
N2			X				
N3							
N4					X		
N5	X	X	X	X	X	X	X
NGR							
PP1					X		
PP2				X	X	X	X
PP3			X			X	X

X indicates that the named behavior occurred. *Utterances where the duration could not be decreased in both L1 and L2 were excluded from this calculation. In other words, this column indicates if more than half of the utterances for which *duration could be decreased in at least one of the languages*, exhibited a greater extent of durational adjustment in L1 compared to L2.

From Table 5.2, it is evident that subjects AOS3, N5, PP2 and PP3 exhibited a greater durational adjustment in L1 for more than 50% of the utterances. It can thus be concluded that speech production in L2 only affected the extent of durational adjustment for these four subjects. With the exception of N5, none of the normal speakers obtained a greater extent of durational adjustment in L2 than in L1 for more than one of their utterances. Consequently the results for the *normal group* indicate that for none of the five utterances in the voiceless plosive group, the extent of durational adjustment was greater in L1 than in L2. PP1 fared similar to the normal

group and also exhibited a greater extent of durational adjustment in L1 for only one of the five utterances.

For two of the three subjects with AOS (AOS2 and AOS3), two of the three subjects with PP (PP2 and PP3) and for N5, more instances occurred in L2 than L1, in which the duration in the FR could not be decreased compared to the duration in the NR. Even though for some of these subjects the appropriate durational change was also not successfully accomplished in L1 either, it occurred for a greater percentage of utterances in L2 in these speakers.

5.2.1.3 Determination of the extent of durational adjustment in L1 versus L2 for *vowel duration* of utterances beginning with a *voiced plosive*: Results for *utterances as a group*

Figure 5.2 provides a visual presentation of the results regarding the extent of durational adjustment in L1 and L2 respectively, for the voiced plosive utterance group. A summary of the findings related to the answering of the questions posed for sub-aim one is tabulated in Table 5.3.

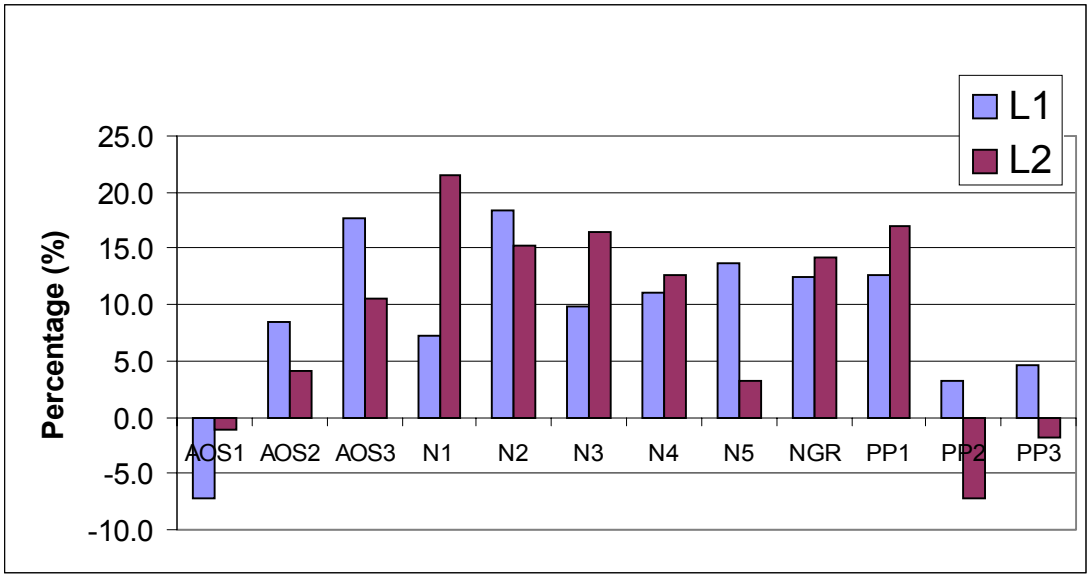

Figure 5.2 **VD in the FR expressed as a percentage of VD in the NR indicating the extent of durational adjustment in the FR compared to the NR in L1 and L2 for utterances beginning with a voiced plosive as a group**

Table 5.3 Findings related to the achievement of durational adjustments in L1 and L2 regarding VD of utterances beginning with a voiced plosive as a group

	Durational adjustment was unsuccessful		Extent of durational adjustment in L1 is greater than in L2	Durational adjustment was only unsuccessful in L2
	L1	L2		
AOS1	X	X	n.a.	
AOS2			X	
AOS3			X	
N1				
N2			X	
N3				
N4				
N5			X	
NGR				
PP1				
PP2		X	X	X
PP3		X	X	X

X indicates that the named behavior occurred.

Regarding the extent of durational adjustment, it is evident from Figure 5.2 and Table 5.3 that AOS2, AOS3, N2, N5, PP2 and PP3 exhibited a greater extent of durational adjustment in L1 than in L2. It is further evident that AOS1 was unable to make an appropriate durational adjustment in either L1 or L2. Consequently, comments regarding the effect of L2 on the extent of durational adjustment in L1 versus L2 cannot be made for this subject. Subjects PP2 and PP3 were unsuccessful in decreasing duration in the FR, only in L2.

Except for AOS3 and PP1, the experimental subjects generally exhibited durational adjustments in the FR compared to the NR which were smaller than those of the normal group. In L1, the normal group exhibited a mean durational adjustment of 12.4%, whereas the durational adjustments for subjects with AOS1 and AOS2 were -7.2% and 8.4%, respectively. Subjects PP2 and PP3 exhibited durational adjustments of 3.2% and 4.6% respectively in L1. For L2 the normal group exhibited a mean durational adjustment of 14.2%, whereas the durational adjustments for subjects AOS2 and AOS3 were –4.0% and 10.5%, respectively. PP2 and PP3 exhibited durational adjustments of –7.1% and –1.9% respectively.

5.2.1.4 Determination of the extent of durational adjustment in L1 versus L2 for *vowel duration* of utterances beginning with a *voiced plosive:* Results for *individual utterances*

Table 5.4 provides a summary of the relevant findings for sub-aim one regarding individual utterances in the voiced plosive utterance group. Regarding extent of durational adjustment in L1 compared to L2, subjects AOS2, AOS3, N2, N5, PP2 and PP3 exhibited more than half of utterances in L1 with a greater extent of durational adjustment than in L2. Only subjects AOS3, N5, PP2 and PP3 exhibited a greater number of utterances in L2 than in L1 where VD in the FR could not be decreased.

Table 5.4 Findings related to the achievement of durational adjustments in L1 and L2 regarding VD of individual utterances beginning with a voiced plosive

	bait/"byt"	buck"/"bak"	bus/"bas"	back/"bek"	bet/"bed"	Durational adjustment was unsuccessful for more L2 utterances than L1 utterances	More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2*
	The extent of durational adjustment for the utterance is greater in L1 than L2						
AOS1	X				X		
AOS2	X	X	X	X	X		X
AOS3	X	X	X		X	X	X
N1							
N2	X	X	X	X	X		X
N3							
N4			X		X		
N5	X	X	X	X	X	X	X
NGR		X					
PP1							
PP2		X	X	X		X	X
PP3		X		X	X	X	X

X indicates that the named behavior occurred. *Utterances where the duration could not be decreased in both L1 and L2 were excluded from this calculation. In other words, this column indicates if more than half of the utterances for which *duration could be decreased in at least one of the languages*, exhibited a greater extent of durational adjustment in L1 compared to L2.

5.2.1.5 Determination of the extent of durational adjustment in L1 versus L2 for *vowel duration* of utterances beginning with a *voiceless fricative*: Results for *utterances as a group*

Figure 5.3 provides a visual presentation of the results regarding the extent of durational adjustment for utterances beginning with a voiceless fricative.

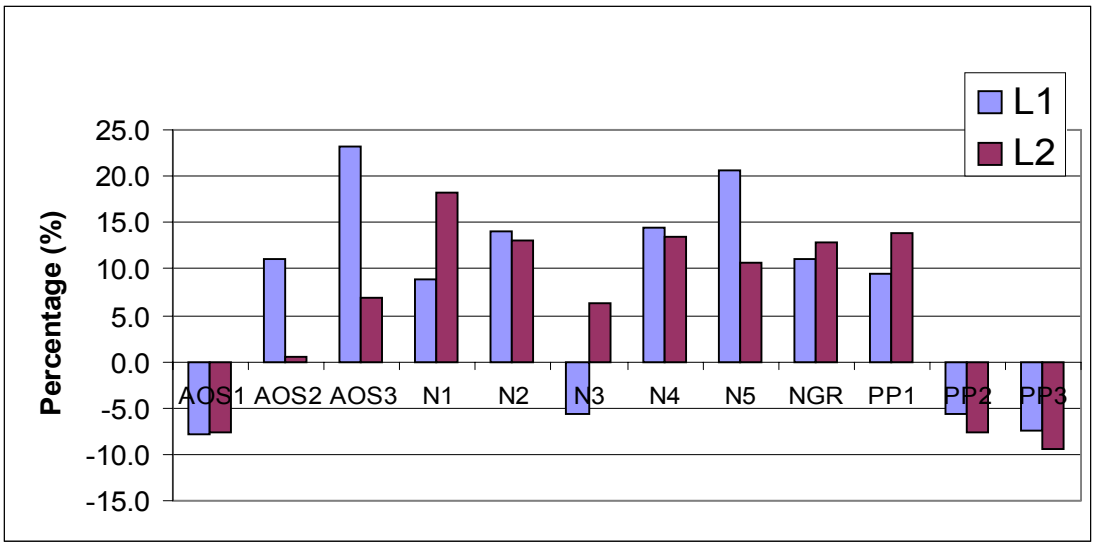

Figure 5.3 **VD in FR expressed as a percentage of VD in NR indicating the extent of durational adjustment in the FR compared to the NR in L1 and L2 for utterances beginning with a voiceless fricative as a group**

Regarding the extent of durational adjustment in L1 compared to L2, it is evident from Figure 5.3 that AOS2, AOS3, N2, N4 and N5 exhibited a greater extent of durational adjustment in L1 than in L2. From Figure 5.3 it is further evident that AOS1, PP2 and PP3 were unable to achieve a shorter duration in the FR compared to the NR in both L1 and L2. Only one normal speaker, N3 was unable to achieve a shorter duration in the FR and this occurred in L1 only. None of the subjects had more instances in L2 than in L1 where duration in the FR could not be decreased. The normal group exhibited a greater extent of durational adjustment (12.8%) in L2 than all the experimental subjects, with the exception of PP1. The extent of durational adjustment of the experimental subjects, excluding PP1, ranged from -9.4% (for PP3) to 6.9% (for AOS3). The findings relevant to answering the questions posed for sub-aim one are summarized in Table 5.5

Table 5.5 Findings related to the achievement of durational adjustments in L1 and L2 regarding VD of utterances beginning with a voiceless fricative as a group

	Durational adjustment was unsuccessful		Extent of durational adjustment in L1 is greater than in L2	Durational adjustment was only unsuccessful in L2
	L1	L2		
AOS1	X	X	n.a.	
AOS2			X	
AOS3			X	
N1				
N2			X	
N3				
N4			X	
N5			X	
NGR				
PP1				
PP2	X	X	n.a.	
PP3	X	X	n.a.	

X indicates that the named behavior occurred.

5.2.1.6 Determination of the extent of durational adjustment in L1 versus L2 for *vowel duration* of utterances beginning with a *voiceless fricative:* Results for *individual utterances*

The results pertaining to sub-aim one for the individual utterances are summarized in Table 5.6. A greater extent of durational adjustment in L1 than in L2, was made for more than half of the utterances by AOS2, AOS3, N2 and N5. Regarding instances where an appropriate durational adjustment (decrease of duration in the FR) could not be made, it is evident that AOS2, AOS3 and PP2 exhibited this behavior more often for L2 utterances than for L1 utterances.

Table 5.6 Findings related to the achievement of durational adjustments in L1 and L2 regarding VD of individual utterances beginning with a voiceless fricative

	set/"set"	fuss/ "vas"	Fête/"feit"	foot/"voet"	Durational adjustment was unsuccessful for more L2 utterances than L1 utterances	More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2*
	The extent of durational adjustment for the utterance is greater in L1 than L2					
AOS1						
AOS2	X	X	X	X	X	X
AOS3	X	X	X	X	X	X
N1						
N2	X	X	X	X		X
N3						
N4		X		X		
N5	X	X	X	X		X
NGR						
PP1		X		X		
PP2		X			X	
PP3						

X indicates that the named behavior occurred. *Utterances where the duration could not be decreased in both L1 and L2 were excluded from this calculation. In other words, this column indicates if more than half of the utterances for which *duration could be decreased in at least one of the languages*, exhibited a greater extent of durational adjustment in L1 compared to L2.

5.2.1.7 Summary of results regarding the extent of durational adjustment for *vowel duration* in L1 and L2

Table 5.7 provides a summary of the findings regarding the extent of durational adjustment for VD in L1 versus L2 for *utterances as a group* and for *individual utterances* in an utterance group. Table 5.7 aims to highlight trends which emerged regarding the effect of speech production in L2 on durational adjustments by indicating if specific events occurred (A, B, C and D). An X indicates that the stated behavior (A, B, C and D) occurred, whereas an open space implies that the stated behavior was absent.

For *utterances as a group*, it is indicated if durational adjustments were unsuccessful in L2 only (behavior A in Table 5.7) and if a greater extent of durational adjustment occurred in L1 than in L2 (behavior B in Table 5.7). For *individual utterances* in each utterance group, it is indicated if durational adjustment was unsuccessful for more L2 utterances than L1 utterances (behavior C in Table 5.7) and if more than half of the utterances exhibited a greater extent of durational adjustment in L1 than in L2 (behavior D in Table 5.7). For *utterances as a group*, "not applicable" (n.a.) is indicated if comments regarding the extent of durational adjustment in L1 compared to L2 could not be made due to the fact that the duration in the FR could not be decreased in either language.

Table 5.7 Summarized findings related to durational adjustments of VD for utterances as a group and individual utterances in each utterance group

Utterance Type	Finding	AOS1	AOS2	AOS3	PP1	PP2	PP3	N1	N2	N3	N4	N5	NGR
Voiceless Plosives													
Utterances as a group	A			X									
	B	n.a.	X	X		n.a.	n.a.					X	
Individual utterances	C		X	X		X	X					X	
	D			X		X	X					X	
Voiced Plosives													
Utterances as a group	A					X	X						
	B	n.a.	X	X		X	X		X			X	
Individual utterances	C			X		X	X					X	
	D		X	X		X	X		X			X	
Fricatives													
Utterances as a group	A												
	B	n.a.	X	X		n.a.	n.a.		X		X	X	
Individual utterances	C		X	X		X							
	D		X	X					X			X	

Utterances as a group:
A=For utterances as a group, durational adjustments were unsuccessful in L2 only
B=For utterances as a group, the extent of durational adjustment was greater in L1 than in L2
Individual utterances in an utterance group:
C= Durational adjustment was unsuccessful for more L2 utterances compared to L1 utterances
D= More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2

From Table 5.7 it is evident that a particular behavior was sometimes reflected by the findings for the individual utterances in a particular utterance group, but not for utterances as a group and vice versa. If a named behavior (A, B, C and D) was reflected by the *individual* or *utterance group findings*, this behavior was regarded as characteristic of the speech production of the specific subject.

From the results depicted in Table 5.7 it appears as if the L2 context affected the named behaviors (A, B, C and D) for AOS2, AOS3 and PP2 for all utterance groups. PP3 was also affected by the L2 context with the exception of the voiceless fricative utterance group. The normal group does not seem to have been affected by the L2 context regarding the named behaviors. However, when the data of individual normal speakers are viewed, it is evident that N2 exhibited a greater extent of durational adjustment in L1 than in L2 for utterances beginning with a voiced plosive and utterances beginning a voiceless fricative. N4 also exhibited a greater extent of durational adjustment in L1 for utterances beginning with a voiceless fricative, whereas N5 exhibited a greater extent of durational adjustment in L1 than in L2 for all utterance groups. N5 also had a larger number of utterances in L1 than in L2, where duration could not be decreased in the FR.

The fact that AOS1 does not feature any of the named behaviors in Table 5.7 is due to the fact that this subject was very seldom able to decrease duration in the FR condition in either L1 or L2. In summary, it appears as if two of the subjects with AOS (AOS2 and AOS3) and two with PP (PP2 and PP3) were affected by the L2 context resulting in temporal control being exerted more successfully in L1. In other words, the aforementioned subjects were more successful regarding achievement of durational adjustments (decrease in duration) in L1 under circumstances of increased demands imposed by an increase in speaking rate. The fact that some of the normal speakers sometimes did not decrease duration in the FR could be indicative of the fact that individual performance differs when rate has to be increased and might suggest that these subjects occasionally produced only the carrier phrase at a faster rate and not necessarily the target word.

5.2.2 Determination of the extent of durational adjustment in L1 versus L2 for *utterance duration*

Utterance duration was measured for utterances beginning with a voiceless plosive, voiced plosive and fricative. The data for each utterance group will be discussed separately.

5.2.2.1 Determination of the extent of durational adjustment in L1 versus L2 for *utterance duration* of utterances beginning with a *voiceless plosive*: Results for *utterances as a group*

In Figure 5.4 the UD in the FR is expressed as a percentage of the UD in the NR for L1 and L2 respectively in order to indicate the extent of durational adjustment in the FR compared to the NR for utterances beginning with a voiceless plosive.

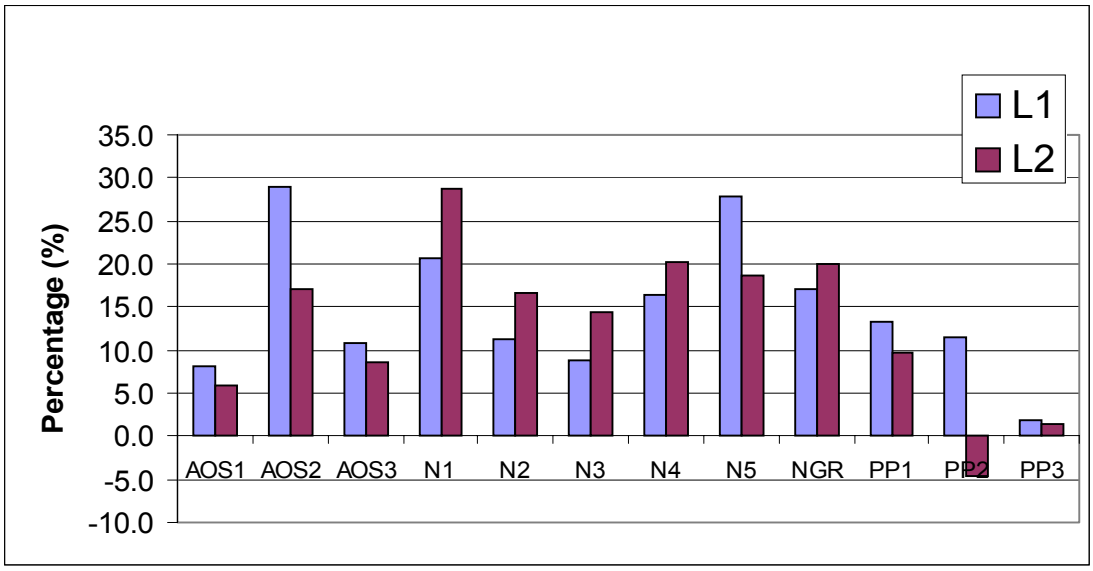

Figure 5.4 UD in FR expressed as a percentage of UD in NR indicating the extent of durational adjustment in the FR compared to the NR in L1 and L2 for utterances beginning with a voiceless plosive as a group

Regarding the extent of durational adjustment it is evident from Figure 5.4 that all three subjects with AOS and PP respectively, as well as N5 exhibited a greater extent of durational adjustment in L1 than in L2. In contrast to the experimental subjects, the normal group exhibited a greater extent of durational adjustment in L2.

This is similar to the finding for the voiceless plosive utterance group regarding durational adjustments for VD. In L2 all the subjects with AOS (5.9%, 17.1% and 8.6% for AOS1, AOS2 and AOS3 respectively) and those with PP (9.8%, -4.5% and 1.4% for PP1, PP2 and PP3 respectively) exhibited a smaller extent of durational adjustment than the normal group (19.9%). From Figure 5.4 it is evident that all the subjects, with the exception of PP2 in L2, were able to decrease duration in the FR in both L1 and L2.

Table 5.8 summarizes the findings pertaining to the questions posed for sub-aim one. As can be seen in Table 5.8, PP2 was thus the only subject who exhibited unsuccessful durational adjustment L2 only.

Table 5.8 Findings related to the achievement of durational adjustments in L1 and L2 regarding UD of utterances beginning with a voiceless plosive as a group

	Durational adjustment was unsuccessful		Extent of durational adjustment in L1 is greater than in L2	Durational adjustment was only unsuccessful in L2
	L1	L2		
AOS1			X	
AOS2			X	
AOS3			X	
N1				
N2				
N3				
N4				
N5			X	
NGR				
PP1			X	
PP2		X	X	X
PP3			X	

X indicates that the named behavior occurred.

5.2.2.2 Determination of the extent of durational adjustment in L1 versus L2 for *utterance duration* of utterances beginning with a *voiceless plosive*: Results for *individual utterances*

Table 5.9 provides a summary of the findings regarding the extent of durational adjustment for individual utterances beginning with a voiceless plosive. Regarding a greater extent of durational adjustment in L1 than in L2, it is evident from Table 5.9 that subjects AOS2, N5 and all three subjects with PP exhibited a greater extent of durational adjustment in L1 for more than half of the utterances beginning with a voiceless plosive. This implies that for these subjects, L1 generally led to

achievement of a greater extent of durational adjustment. L2 thus seems to have influenced the extent of durational adjustment negatively in these subjects.

Table 5.9 Findings related to the achievement of durational adjustments in L1 and L2 regarding UD of individual utterances beginning with a voiceless plosive

	puck/"pak"	pet/"pet"	pit/"pit"	putt/"pad"	pup/"pap"	Durational adjustment was unsuccessful for more L2 utterances than L1 utterances	More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2*
	The extent of durational adjustment for the utterance is greater in L1 than L2						
AOS1	X		X				
AOS2	X	X	X	X	X		X
AOS3			X	X		X	
N1				X	X		
N2		X			X		
N3	X						
N4	X						
N5		X	X	X	X		X
NGR					X		
PP1		X	X	X		X	X
PP2	X		X	X	X	X	X
PP3			X		X	X	X

X indicates that the named behavior occurred. *Utterances where the duration could not be decreased in both L1 and L2 were excluded from this calculation. In other words, this column indicates if more than half of the utterances for which *duration could be decreased in at least one of the languages*, exhibited a greater extent of durational adjustment in L1 compared to L2.

Regarding the number of utterances in L1 and L2, in which a shorter duration could not be obtained in the FR, it is evident that AOS3 and all three PP subjects were unsuccessful in decreasing duration in the FR for more L2 utterances than L1 utterances. The normal speakers were always successful in decreasing duration in the FR compared to the NR.

5.2.2.3 Determination of the extent of durational adjustment in L1 versus L2 for *utterance duration* of utterances beginning with a *voiced plosive*: Results for *utterances as a group*

Figure 5.5 entails a visual presentation of UD in the FR as a percentage of UD duration in the NR for L1 and L2 for utterances beginning with a voiced plosive as a group. The findings pertaining to the questions posed for sub-aim one for UD of the voiced plosive utterance group are summarized in Table 5.10.

Regarding the extent of durational adjustment in L1 compared to L2, subjects AOS2, AOS3, N2, N5, PP1 and PP2 exhibited a greater extent of durational adjustment in L1 than in L2. The normal group's extent of durational adjustment in L1 compared to L2 differed by only 0.8%, indicating that as a group the extent of durational adjustment in L1 and L2 was very similar.

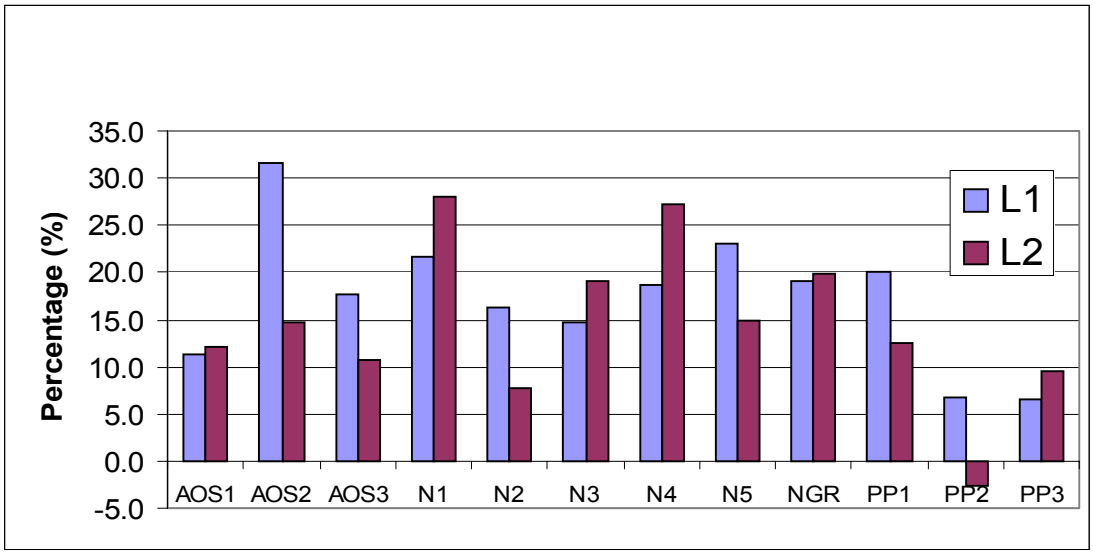

Figure 5.5 UD in FR expressed as a percentage of UD in NR indicating the extent of durational adjustment in the FR compared to the NR in L1 and L2 for utterances beginning with a voiced plosive as a group

Table 5.10 Findings related to the achievement of durational adjustments in L1 and L2 regarding UD of utterances beginning with a voiced plosive as a group

	Durational adjustment was unsuccessful		Extent of durational adjustment in L1 is greater than in L2	Durational adjustment was only unsuccessful in L2
	L1	L2		
AOS1				
AOS2			X	
AOS3			X	
N1				
N2			X	
N3				
N4				
N5			X	
NGR				
PP1			X	
PP2		X	X	X
PP3				

X indicates that the named behavior occurred.

AOS1 had a slightly greater extent of durational adjustment in L2 with the difference between the percentage values of L1 and L2 being only 0.7%. Both AOS2 and AOS3 exhibited quite a big difference between their extent of durational adjustment in L1 and L2. For AOS2 the difference between the durational adjustments in L1 and L2 was 16.9% and for AOS3 it was 7.6%. PP1 exhibited a difference of 7.4%, and PP2 a difference of 9.5%, between the extent of durational adjustment in L1 and L2.

As with the voiceless plosive utterance group, only PP2 was not able to obtain a shorter duration in the FR compared to the NR in L2 only. Achievement of durational adjustments thus appears to have been negatively influenced by L2 in this subject. In L2, all the experimental subjects had a smaller extent of durational adjustment than the normal group, with the extent of durational adjustments ranging from 10.6% to 14.7% for the subjects with AOS and from –2.7% to 12.6% for the subjects with PP. The normal group exhibited an extent of durational adjustment of 19.9% in L2.

5.2.2.4 Determination of the extent of durational adjustment in L1 versus L2 for *utterance duration* of utterances beginning with a *voiced plosive*: Results for *individual utterances*

The findings pertaining to the questions posed for sub-aim one regarding individual utterances beginning with a voiced plosive are summarized in Table 5.11. From the results indicated in Table 5.11 it is evident that only N2, PP1 and PP2 were unsuccessful regarding the achievement of durational adjustments more often for L2 utterances than for L1 utterances. Regarding the extent of durational adjustment in L1 compared to L2, subjects AOS2, AOS3, N2, N5 and all subjects with PP exhibited a greater extent of durational adjustment in L1 than in L2 for more than half of the utterances in the voiced plosive utterance group.

Table 5.11 Findings related to the achievement of durational adjustments in L1 and L2 regarding UD of individual utterances beginning with a voiced plosive

	bait/"byt"	buck"/"bak"	bus/"bas"	back/"bek"	bet/"bed"	Durational adjustment was unsuccessful for more L2 utterances than L1 utterances	More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2*
	The extent of durational adjustment for the utterance is greater in L1 than L2						
AOS1	X	X					
AOS2	X	X	X	X	X		X
AOS3	X	X	X		X		X
N1		X					
N2	X	X	X		X	X	X
N3		X					
N4			X				
N5	X	X		X			X
NGR	X	X					
PP1	X		X	X	X	X	X
PP2	X	X	X		X	X	X
PP3		X	X		X		X

X indicates that the named behavior occurred. *Utterances where the duration could not be decreased in both L1 and L2 were excluded from this calculation. In other words, this column indicates if more than half of the utterances for which *duration could be decreased in at least one of the languages*, exhibited a greater extent of durational adjustment in L1 compared to L2.

5.2.2.5 Determination of the extent of durational adjustment in L1 versus L2 for *utterance duration* of utterances beginning with a *voiceless fricative*: Results for *utterances as a group*

Figure 5.6 displays UD in the FR as a percentage of UD in the NR for utterances beginning with a voiceless fricative as a group, while Table 5.12 provides a summary of the findings pertaining to the questions posed for sub-aim one.

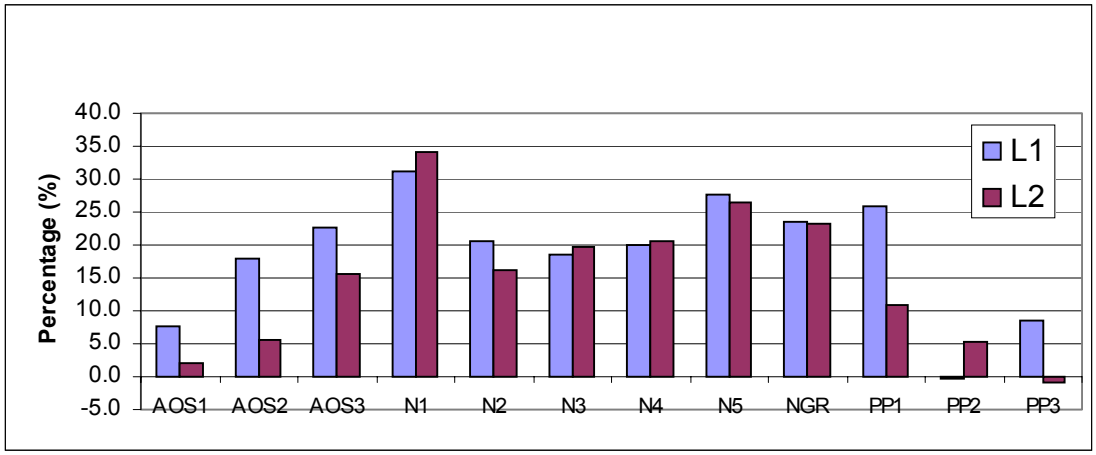

Figure 5.6 **UD in FR expressed as a percentage of UD in NR indicating the extent of durational adjustment in the FR compared to the NR in L1 and L2 for utterances beginning with a voiceless fricative as a group**

Table 5.12 **Findings related to the achievement of durational adjustments in L1 and L2 regarding UD of utterances beginning with a voiceless fricative as a group**

	Durational adjustment was unsuccessful		Extent of durational adjustment in L1 is greater than in L2	Durational adjustment was only unsuccessful in L2
	L1	L2		
AOS1			X	
AOS2			X	
AOS3			X	
N1				
N2			X	
N3				
N4				
N5			X	
NGR			X	
PP1			X	
PP2	X			
PP3		X	X	X

X indicates that the named behavior occurred.

From Figure 5.6 and Table 5.12 it is evident that all the experimental and normal subjects, with the exception of N1, N3, N4 and PP2, exhibited a greater extent of durational adjustment in L1 compared to L2. As with the voiced plosive utterance group, the normal group exhibited a very similar extent of durational adjustment in L1

and L2, with the percentage of durational adjustment for L1 and L2 differing by only 0.3%. The difference between the extent of durational adjustment in L1 and L2 was generally quite small for the individual normal speakers who exhibited a greater extent of durational adjustment in L1 (4.4% for N2 and 0.9% for N5). The difference between the percentage of durational adjustment in L1 and L2 was much larger in the subjects with AOS (5.7% for AOS1, 12.4% for AOS2 and 7.0% for AOS3) and the subjects with PP (15% for PP1 and 9.2% for PP3) who achieved a greater extent of durational adjustment in L1.

Regarding an inability to decrease duration in the FR, only PP2 was unable to decrease duration in the FR in L1 and PP3 in L2. Other than this, all the experimental and normal subjects were able to decrease duration in the FR. Consequently, only PP3 was unsuccessful regarding achievement of durational adjustments in L2 only.

All the subjects with AOS, as well as PP2 and PP3 exhibited smaller percentages of durational adjustment than the normal group in both L1 and L2. In L1, the extent of durational adjustment ranged from 7.7% to 22.7% for the subjects with AOS and from –0.3% to 8.4% for the two subjects with PP, while that of the normal group was 23.6%. In L2, the normal group had an extent of durational adjustment of 23.3%, while the extent of durational adjustment ranged from 2.0% to 15.7% for the subjects with AOS and from –0.8% to 11% for PP1 and PP2.

5.2.2.6 Determination of the extent of durational adjustment in L1 versus L2 for *utterance duration* of utterances beginning with a *voiceless fricative*: Results for *individual utterances*

The results pertaining to the questions posed for sub-aim one of individual utterances beginning with a voiceless fricative are summarized in Table 5.13. It is evident from Table 5.13 that subjects AOS1, AOS2, N2, normal speakers as a group, PP1 and PP2 exhibited a greater extent of durational adjustment in L1 for more than half of the utterances in the voiceless fricative utterance group. For these subjects the L2 context thus appears to have influenced the extent of durational adjustment negatively in it led to achievement of a smaller extent of durational adjustment. Subjects AOS3 and PP2 exhibited a greater extent of durational adjustment in L1 for half of the target

utterances in the voiceless fricative utterance group and a greater extent of durational adjustment in L2 for the other half.

Table 5.13 Findings related to the achievement of durational adjustments in L1 and L2 regarding UD of individual utterances beginning with a voiceless fricative

	set/"set"	fuss/ "vas"	Fête/"feit"	foot/"voet"	Durational adjustment was unsuccessful for more L2 utterances than L1 utterances	More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2*
	The extent of durational adjustment for the utterance is greater in L1 than L2					
AOS1	X	X	X		X	X
AOS2	X	X	X	X	X	X
AOS3			X	X		
N1			X			
N2	X	X	X	X		X
N3	X	X				
N4			X	X		
N5	X		X			
NGR	X		X	X		X
PP1	X	X	X	X	X	X
PP2	X		X			
PP3	X	X			X	X

X indicates that the named behavior occurred. *Utterances where the duration could not be decreased in both L1 and L2 were excluded from this calculation. In other words, this column indicates if more than half of the utterances for which *duration could be decreased in at least one of the languages*, exhibited a greater extent of durational adjustment in L1 compared to L2.

Regarding an inability to decrease UD in the FR, it is evident from Table 5.13 that AOS1, AOS2, PP1 and PP3 were unsuccessful in decreasing duration in the FR for more L2 utterances than L1 utterances. PP2 had an equal number of utterances in each language where UD in the FR could not be decreased. Although this subject thus has difficulty with the accomplishment of durational adjustment, this was not influenced by the L2 context. None of the normal speakers exhibited instances where the duration in the FR could not be decreased.

5.2.2.7 Summary of results regarding the extent of durational adjustment of utterance duration in L1 and L2

Table 5.14 provides a summary of the findings regarding the extent of durational adjustment for UD in L1 versus L2 for *utterances as a group* and for *individual utterances* in an utterance group. Table 5.14 aims to highlight trends which emerged regarding the effect of speech production in L2 on durational adjustment for UD by indicating the occurrence of specific behaviors (A, B, C and D). The same behaviors (A, B, C and D) are indicated and in the same manner as was done for VD (see 5.2.1.7).

Table 5.14 Summarized findings related to durational adjustments of UD for utterances as a group and individual utterances in each utterance group

Utterance Type	Finding	AOS1	AOS2	AOS3	PP1	PP2	PP3	N1	N2	N3	N4	N5	NGR
Voiceless Plosives													
Utterances as a group	A					X							
	B	X	X	X	X	X	X					X	
Individual utterances	C			X	X	X	X						
	D		X		X	X	X					X	
Voiced Plosives													
Utterances as a group	A					X							
	B		X	X	X	X			X			X	
Individual utterances	C				X	X			X				
	D		X	X	X	X	X		X			X	
Fricatives													
Utterances as a group	A						X						
	B	X	X	X	X		X		X			X	X
Individual utterances	C	X	X		X		X						
	D	X	X		X		X		X				X

Utterances as a group:
A=For utterances as a group, durational adjustments were unsuccessful in L2 only
B=For utterances as a group, the extent of durational adjustment was greater in L1 than in L2
Individual utterances in an utterance group:
C= Durational adjustment was unsuccessful for more L2 utterances compared to L1 utterances
D= More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2

From Table 5.14 it is evident that L2 appears to have influenced temporal control in AOS2, AOS3, PP1, PP3 and N5 regarding extent of durational adjustment in all three utterance groups. The aforementioned subjects all obtained a greater extent of durational adjustment in L1 compared to L2 for all three utterance groups as evidenced by the findings for either the utterances as a group and/or for more than half of the utterances in each utterance group. AOS1 seems to have been influenced by L2 regarding the extent of durational adjustment for the voiceless plosive and voiceless fricative utterance groups, whereas PP2 exhibited a greater extent of durational adjustment in L1 for both the voiceless and voiced plosive utterance groups. Subject N2 also exhibited a greater extent of durational adjustment in L1 for the voiced plosive and voiceless fricative utterance groups. The normal group does not appear to have been consistently influenced by the L2 context regarding the extent of durational adjustment, and only exhibited a greater extent of durational adjustment in L1 for the voiceless fricative utterance group.

From the results in Table 5.14 it is further evident that AOS1 and AOS2 exhibited more L2 utterances than L1 utterances where duration in the FR could not be

decreased, but only for the voiceless fricative utterance group. PP2 was unsuccessful in decreasing duration in the FR for more L2 than L1 utterances regarding all three utterance groups, whereas this behavior occurred only in the voiced and voiceless plosive utterance groups for PP2 and in the voiceless plosive and voiceless fricative groups for PP3. It thus appears as if the different utterance groups influenced the various subjects differently.

In summary, it is evident that the L2 context influenced the subjects with either AOS or PP to a greater extent than the normal speakers regarding the achievement of a greater extent of durational adjustment in L1 than in L2. However, two of the normal speakers, N2 and N5, appear to have been influenced by L2 regarding the extent of durational adjustment. With the exception of N2, none of the normal speakers exhibited an inability to decrease duration in the FR more often in L2. All the subjects with either AOS or PP exhibited an inability to decrease duration in the FR more often in L2 than in L1, in at least one of the three utterance groups.

5.2.3 Determination of the extent of durational adjustment in L1 versus L2 for *utterance onset duration*

UOD was only measured for utterances beginning with either a voiceless or voiced plosive, since utterances beginning with a voiceless fricative did not have a period of silence displaying no acoustic energy between the end of the carrier phrase and the beginning of the target utterance, as is the case with utterances beginning with a plosive. The reason for this is that plosive sounds have a period of constriction for their production. The data for each utterance group will be discussed separately.

5.2.3.1 Determination of the extent of durational adjustment in L1 versus L2 for *utterance onset duration* of utterances beginning with a *voiceless plosive*: Results for *utterances as a group*

For description of the results regarding durational adjustment of UOD, the reader is referred to Figure 5.7 and to Table 5.15 for a summary of the results pertaining to the questions which were posed for sub-aim one.

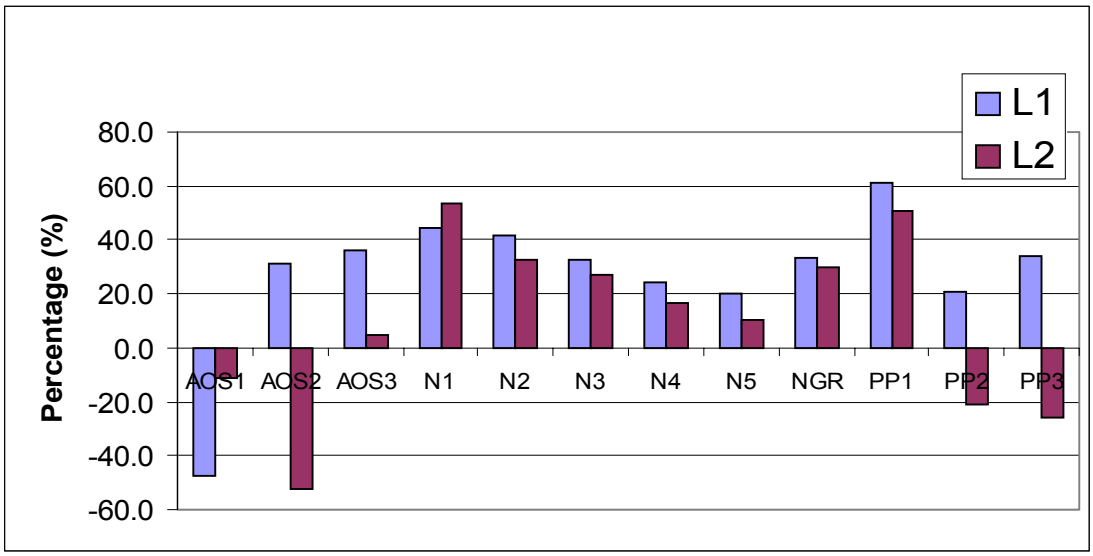

Figure 5.7 UOD in FR expressed as a percentage of UOD in NR indicating the extent of durational adjustment in the FR compared to the NR in L1 and L2 for utterances beginning with a voiceless plosive as a group

Table 5.15 Findings related to the achievement of durational adjustments in L1 and L2 regarding UOD of utterances beginning with a voiceless plosive as a group

	Durational adjustment was unsuccessful		Extent of durational adjustment in L1 is greater than in L2	Durational adjustment was only unsuccessful in L2
	L1	L2		
AOS1	X	X	n.a.	
AOS2		X	X	X
AOS3			X	
N1				
N2			X	
N3			X	
N4			X	
N5			X	
NGR			X	
PP1			X	
PP2		X	X	X
PP3		X	X	X

X indicates that the named behavior occurred.

Regarding the extent of durational adjustment in L1 compared to L2 it is evident from Figure 5.7 and Table 5.15 that all subjects, with the exception of AOS1 and N1, exhibited a greater extent of durational adjustment in the FR in L1 than in L2. For the normal group, the difference between the extent of durational adjustment in L1 and L2 was quite small (3.8%), indicating that durational adjustments were achieved to much the same extent in both languages. In contrast to the aforementioned result, the difference between the extent of durational adjustment in L1 and L2 ranged from 31.5% to 83.1% for AOS2 and AOS3 and from 10.8% to 59.5% for the subjects with PP, which is much larger than the difference for the normal group. This implies that

speaking in L2 had a greater effect on accomplishment of durational adjustments in the experimental subjects than in the normal group, since the experimental subjects were able to obtain a much greater extent of durational adjustment in L1 than in L2.

From Figure 5.7 and Table 5.15 it is evident that AOS1 was unable to decrease UOD in the FR in both L1 and L2. This implies that when the speaking rate had to be increased, production resulted in a longer UOD in the FR than during the NR in both languages. Subjects AOS2, PP2 and PP3 failed to achieve a shorter UOD in the FR in L2 only, indicating that this context presumably influenced temporal control negatively in these subjects.

In L1, the extent of durational adjustment of AOS2, AOS3, PP2 and PP3 generally fell within the range of that of the normal subjects. The extent of durational adjustment for the aforementioned experimental subjects ranged from 20.7% (PP2) to 63.2% (AOS3), while the extent of durational adjustment for the normal speakers in L1 ranged from 20.4% (N5) to 44.7% (N1).

5.2.3.2 Determination of the extent of durational adjustment in L1 versus L2 for *utterance onset duration* of utterances beginning with a *voiceless plosive*: Results for *individual utterances*

Table 5.16 provides a summary of the findings regarding the extent of durational adjustment for UOD for individual utterances in the voiceless plosive utterance group. From this table it is evident that AOS2, AOS3, all normal speakers, with the exception of N1 and all subjects with PP, achieved a greater extent of durational adjustment L1 than in L2 for more than half of the utterances in this utterance group. This implies that temporal adjustments were achieved to a greater extent in L1 in these subjects when the demands were increased with an increase in speaking rate.

Table 5.16 Findings related to the achievement of durational adjustments in L1 and L2 regarding UOD of individual utterances beginning with a voiceless plosive

	puck/"pak"	pet/"pet"	pit/"pit"	putt/"pad"	pup/"pap"	Durational adjustment was unsuccessful for more L2 utterances than L1 utterances	More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2*
	The extent of durational adjustment for the utterance is greater in L1 than L2						
AOS1		X					
AOS2	X	X	X	X		X	X
AOS3	X	X	X		X	X	X
N1							
N2	X		X	X	X		X
N3	X	X	X		X		X
N4	X		X	X			X
N5	X	X	X	X	X		X
NGR	X		X	X			X
PP1			X	X	X		X
PP2	X	X	X		X	X	X
PP3	X	X	X	X	X	X	X

X indicates that the named behavior occurred. *Utterances where the duration could not be decreased in both L1 and L2 were excluded from this calculation. In other words, this column indicates if more than half of the utterances for which *duration could be decreased in at least one of the languages*, exhibited a greater extent of durational adjustment in L1 compared to L2.

Subjects AOS2, AOS3, PP2 and PP3 were more often unsuccessful regarding the achievement of durational adjustments when producing L2 utterances than when producing L1 utterances. Subject AOS1 exhibited difficulty with decreasing duration in the FR in both L1 and L2. Subject PP1 and all the normal speakers were successful regarding decreasing duration in the FR for all utterances in both L1 and L2.

5.2.3.3 Determination of the extent of durational adjustment in L1 versus L2 for *utterance onset duration* of utterances beginning with a *voiced plosive*: Results for *utterances as a group*

Figure 5.8 displays the durational adjustment in L1 and L2 respectively for UOD of utterances beginning with a voiced plosive as a group. The findings pertaining to the questions posed for sub-aim one are summarized in Table 5.17.

Regarding the extent of durational adjustment in L1 compared to L2, it is evident that AOS1, AOS3, N2, N3, N5, PP2 and PP3 exhibited a greater extent of durational adjustment in L1 compared to L2. The normal group had a very similar extent of durational adjustment in L1 and L2, with the percentage values for the two languages differing by only 0.1%. The difference between the durational adjustment in L1 and L2 for AOS1 was 5.3% and for PP2, 8.3%. When viewing the data of the individual normal speakers, the differences between L1 and L2 were also quite big, however, ranging from 3.3% (N4) to 18.7% (N5).

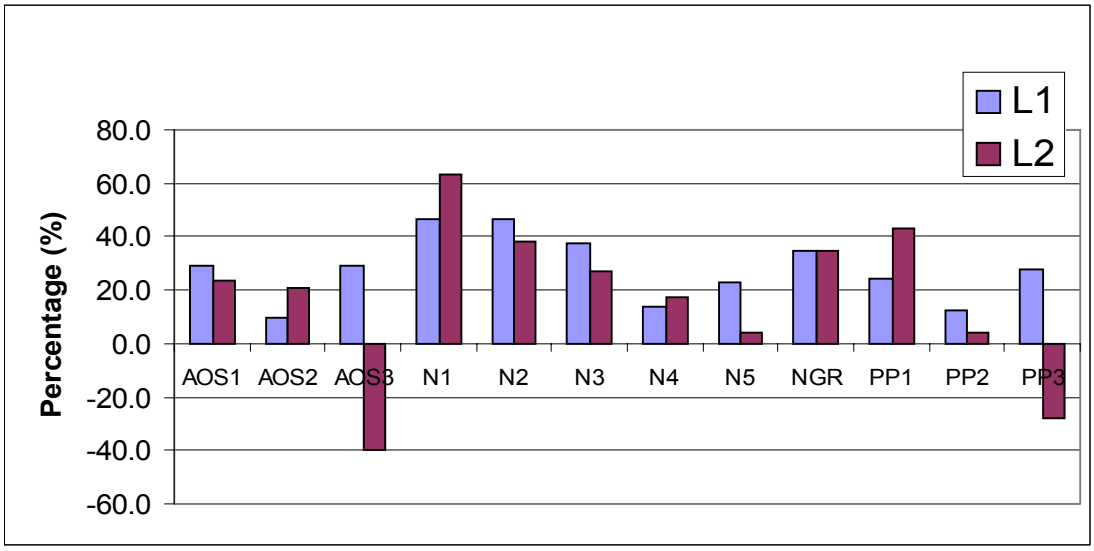

Figure 5.8 UOD in FR expressed as a percentage of UOD in NR indicating the extent of durational adjustment in the FR compared to the NR in L1 and L2 for utterances beginning with a voiced plosive as a group

Table 5.17 Findings related to the achievement of durational adjustments in L1 and L2 regarding UOD of utterances beginning with a voiced plosive as a group

	Durational adjustment was unsuccessful		Extent of durational adjustment in L1 is greater than in L2	Durational adjustment was only unsuccessful in L2
	L1	L2		
AOS1			X	
AOS2				
AOS3		X	X	X
N1				
N2			X	
N3			X	
N4				
N5			X	
NGR				
PP1				
PP2			X	
PP3		X	X	X

X indicates that the named behavior occurred.

From Figure 5.8 and Table 5.17, it is further evident that only AOS3 and PP3 were not successful in decreasing duration in the FR in L2 utterances only. These two subjects thus appear to exhibit greater difficulty with achievement of durational adjustments in L2.

5.2.3.4 Determination of the extent of durational adjustment in L1 versus L2 for *utterance onset duration* of utterances beginning with a *voiced plosive*: Results for *individual utterances*

The results pertaining to the extent of durational adjustment in L1 and L2 of individual utterances beginning with a voiced plosive are summarized in Table 5.18.

Table 5.18 Findings related to the achievement of durational adjustments in L1 and L2 regarding UOD of individual utterances beginning with a voiced plosive

	bait/"byt"	buck"/"bak"	bus/"bas"	back/"bek"	bet/"bed"	Durational adjustment was unsuccessful for more L2 utterances than L1 utterances	More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2*
	The extent of durational adjustment for the utterance is greater in L1 than L2						
AOS1	X			X			
AOS2		X					
AOS3	X	X		X		X	X
N1							
N2	X	X	X	X	X		X
N3	X	X	X	X			X
N4			X	X	X		X
N5	X	X	X	X	X	X	X
NGR	X			X	X		X
PP1		X	X				
PP2		X	X	X		X	X
PP3	X		X	X			X

X indicates that the named behavior occurred. *Utterances where the duration could not be decreased in both L1 and L2 were excluded from this calculation. In other words, this column indicates if more than half of the utterances for which *duration could be decreased in at least one of the languages*, exhibited a greater extent of durational adjustment in L1 compared to L2.

From Table 5.18 it is evident that AOS3, PP2, PP3 and all the normal speakers, with the exception of N1, exhibited a greater extent of durational adjustment in L1 than in L2 for more than half of the utterances in the voiced plosive utterance group. This result implies that durational adjustment generally accomplished to a greater extent in L1 utterances when the demands were increased with an increase in speaking rate. Furthermore, durational adjustment was unsuccessful for more L2 than L1 utterances in AOS3, PP2 and N5. All the normal speakers were able to decrease duration in the FR for all utterances in both L1 and L2, with the exception of N5 who was unable to obtain a shorter duration in the FR for "bait" in L2 (see Appendix C). Subjects AOS1, AOS2 and PP1 also had instances where duration in the FR could not be decreased, although this did not occur more often in L2 than in L1, implying that L2 did not lead to greater difficulty with the accomplishment of durational adjustments in these subjects.

5.2.3.5 Summary of results regarding the extent of durational adjustment of utterance onset duration in L1 and L2

Table 5.19 summarizes the findings regarding the extent of durational adjustment in L1 and L2 for UOD regarding *utterances as a group* and *individual utterances* in each of the three utterance groups. The behaviors (A, B, C and D) indicated in this table are similar to the previous tables regarding VD (Table 5.7) and UD (Table 5.14).

Table 5.19 Summarized findings related to durational adjustments of UOD for utterances as a group and individual utterances in the voiceless plosive and voiced plosive utterance groups

Utterance Type	Finding	AOS1	AOS2	AOS3	PP1	PP2	PP3	N1	N2	N3	N4	N5	NGR
Voiceless Plosives													
Utterances as a group	A		X			X	X						
	B	n.a.	X	X	X	X	X		X	X	X	X	X
Individual utterances	C		X	X		X	X						
	D		X	X	X	X	X		X	X	X	X	X
Voiced Plosives													
Utterances as a group	A			X			X						
	B	X		X		X	X		X	X		X	
Individual utterances	C			X		X						X	
	D			X		X	X		X	X	X	X	X

Utterances as a group:
A=For utterances as a group, durational adjustments were unsuccessful in L2 only
B=For utterances as a group, the extent of durational adjustment was greater in L1 than in L2
Individual utterances in an utterance group:
C= Durational adjustment was unsuccessful for more L2 utterances compared to L1 utterances
D= More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2

From Table 5.19 it is evident that the L2 context appears to have influenced the extent of durational adjustment regarding UOD negatively for both the voiceless and voiced plosive utterance groups in AOS3, PP2, PP3 and all the normal speakers with the exception of N1. The reason for concluding that the L2 context influenced the extent of durational adjustment negatively is the fact that all the aforementioned speakers obtained a greater extent of durational adjustment in L1 compared to L2. AOS1 exhibited a greater extent of durational adjustment in L1 for the voiced plosive utterance group, but was unable to decrease duration in the FR in both L1 and L2 regarding the voiceless plosive utterance group. AOS2 and PP1 exhibited a greater extent of durational adjustment in L1 for only the voiceless plosive utterance group.

AOS3, PP2 and PP3 were unsuccessful regarding decreasing duration in the FR more often in L2 than in L1 for both the voiced and voiceless plosive utterance groups, indicating that difficulty with temporal control under circumstances of increased

demand became more apparent whilst speaking in L2 in these subjects. AOS2 was unsuccessful in decreasing duration in the FR more often in L2, only for the voiceless plosive utterance group. The normal speakers did not exhibit difficulty with decreasing duration in the FR with the exception of N5 for one utterance in the voiced plosive group in L2.

5.2.4 Determination of the extent of durational adjustment in L1 versus L2 for *voice onset time*

Voice onset time was measured for utterances beginning with either a voiced or voiceless plosive, although only the data for the voiceless plosives will be reported for sub-aim one. Because utterances beginning with a voiced plosive often displayed a negative VOT (voicing lead), it was not possible to use the formula which was compiled to determine the extent of durational adjustment of a temporal parameter in the FR compared to the NR. The reason for this was that a negative percentage value would not necessarily have reflected that the VOT was longer in the FR, as was the case with the other temporal parameters, since it might merely have been due to the fact that a negative VOT value had been used for calculation. Because of this, it was decided to use only the data from the voiceless plosive utterance group. It was predicted that VOT would decrease in the FR compared to the NR in normal speakers (Kessinger & Blumstein, 1998).

5.2.4.1 Determination of the extent of durational adjustment in L1 versus L2 for *voice onset time* of utterances beginning with a *voiceless plosive*: Results for *utterances as a group*

Figure 5.9 provides a visual presentation of durational adjustment regarding VOT in L1 and L2 respectively, for the voiceless plosive utterance group. Regarding the extent of durational adjustment in the FR in L1 compared to L2, it is evident that only N4, PP2 and PP3 exhibited a greater extent of durational adjustment in the FR in L1 than in L2. It thus appears as if VOT is not influenced to the same extent by the L2 context as the other measured temporal parameters where the extent of durational adjustment in speakers with AOS and those with PP was generally greater in L1. Furthermore, it is evident from Figure 5.9 that AOS1, N2 and N3 was unsuccessful at

decreasing VOT in the FR in L1, whereas PP2 had difficulty decreasing VOT in the FR in L2.

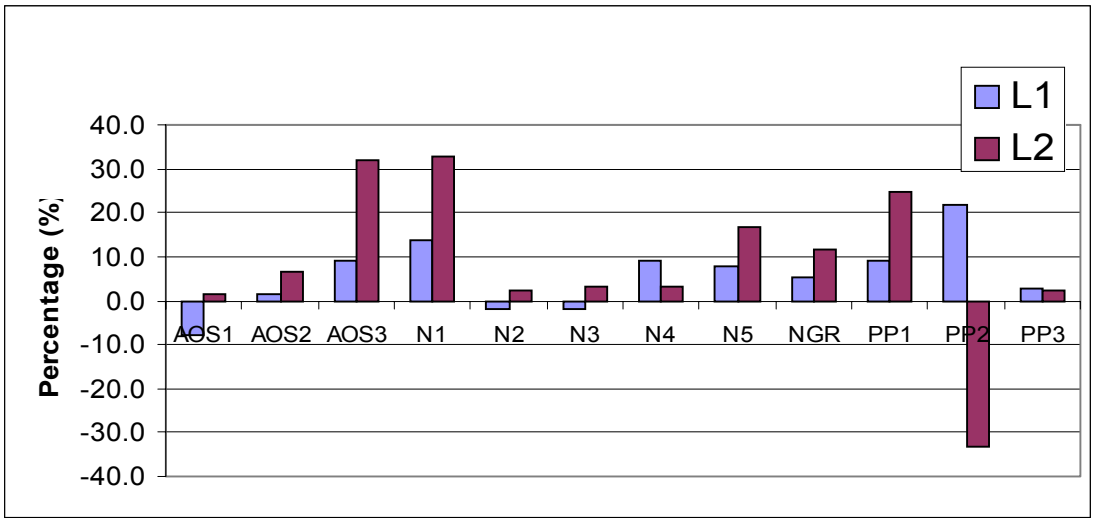

Figure 5.9 VOT in FR expressed as a percentage of VOT in NR indicating the extent of durational adjustment in the FR compared to the NR in L1 and L2 for utterances beginning with a voiceless plosive as a group

The findings pertaining to the questions posed for sub-aim one are summarized in Table 5.20.

Table 5.20 Findings related to the achievement of durational adjustments in L1 and L2 regarding VOT of utterances beginning with a voiceless plosive as a group

	Durational adjustment was unsuccessful		Extent of durational adjustment in L1 is greater than in L2	Durational adjustment was only unsuccessful in L2
	L1	L2		
AOS1	X			
AOS2				
AOS3				
N1				
N2	X			
N3	X			
N4			X	
N5				
NGR				
PP1				
PP2		X	X	X
PP3			X	

X indicates that the named behavior occurred.

From Table 5.20, it can be concluded that L2 does not seem to cause difficulty with the achievement of durational adjustment, nor does it influence the extent of durational adjustment negatively, since most subjects achieved a greater extent of durational adjustment in L2 than in L1. VOT does not seem as susceptible to the

influence of L2 under circumstances where additional motor demands are placed on the speech production mechanism with an increase in speaking rate.

5.2.4.2 Determination of the extent of durational adjustment in L1 versus L2 for *voice onset time* of utterances beginning with a *voiceless plosive*: Results for *individual utterances*

The results regarding the questions posed for sub-aim one are summarized in Table 5.21.

Table 5.21 Findings related to the achievement of durational adjustments in L1 and L2 regarding VOT of individual utterances beginning with a voiceless plosive

	puck/"pak"	pet/"pet"	pit/"pit"	putt/"pad"	pup/"pap"	Durational adjustment was unsuccessful for more L2 utterances than L1 utterances	More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2*
	The extent of durational adjustment for the utterance is greater in L1 than L2						
AOS1				X	X	X	
AOS2					X		
AOS3		X					
N1					X		
N2			X	X	X	X	X
N3			X				
N4	X	X		X		X	X
N5			X	X			
NGR				X	X		
PP1	X		X				
PP2	X	X	X	X		X	X
PP3					X		

X indicates that the named behavior occurred. *Utterances where the duration could not be decreased in both L1 and L2 were excluded from this calculation. In other words, this column indicates if more than half of the utterances for which *duration could be decreased in at least one of the languages*, exhibited a greater extent of durational adjustment in L1 compared to L2.

From Table 5.21 it is evident that only N2, N4 and PP2 displayed a greater extent of durational adjustment in L1 than in L2 for more than half of the utterances in the voiceless plosive utterance group. Furthermore, it is evident that only AOS1, N2, N4 and PP2 were unable to decrease duration in the FR, more often in L2 utterances than in L1 utterances. It is interesting to note, however, that all the normal speakers, with the exception of N1, exhibited utterances in either L1 and/or L2 where duration in the FR was not decreased. It thus appears as if decreasing VOT in the FR is not necessarily characteristic of normal speech production. In summary, it thus appears as if the experimental subjects (AOS and PP) performed similarly to the normal group regarding achievement of durational adjustments for VOT.

5.2.4.3 Summary of results regarding the extent of durational adjustment of voice onset time in L1 and L2

The results pertaining to the extent of durational adjustment of VOT in L1 and L2 for the three utterance groups and for individual utterances in each utterance group are summarized in Table 5.22.

Table 5.22 Summarized findings related to durational adjustments of VOT for utterances as a group and individual utterances in the voiceless plosive utterance group

Utterance Type	Finding	AOS1	AOS2	AOS3	PP1	PP2	PP3	N1	N2	N3	N4	N5	NGR
Voiceless Plosives													
Utterances as a group	A					X							
	B					X	X				X		
Individual utterances	C	X				X			X		X		
	D					X			X		X		

Utterances as a group:
A=For utterances as a group, durational adjustments were unsuccessful in L2 only
B=For utterances as a group, the extent of durational adjustment was greater in L1 than in L2
Individual utterances in an utterance group:
C= Durational adjustment was unsuccessful for more L2 utterances compared to L1 utterances
D= More than half of the utterances exhibited a greater extent of durational adjustment in L1 compared to L2

From Table 5.22 it is evident that L2 does not seem to have had a consistent influence on the extent of durational adjustment in L1 compared to L2 or the inability to achieve a shorter duration in the FR in L2. The normal speakers, with the exception of N1, also exhibited instances where VOT in the FR was not decreased and it thus seems as if VOT is not necessarily decreased when increasing speaking rate. The subjects with PP and those with AOS, with the exception of PP2, thus seem to have performed similarly to the normal speakers regarding durational adjustments for VOT.

5.3 RESULTS FOR SUB-AIM TWO: DETERMINATION OF THE CONTEXT (L1NR, L1FR, L2NR OR L2FR) IN WHICH EACH EXPERIMENTAL SUBJECT DIFFERED MOST FROM THE NORMAL GROUP REGARDING EACH TEMPORAL PARAMETER

For this sub-aim it was predicted that if the mean durations of the experimental subjects were to differ from those of the normal group, this difference would be most evident in the context which placed the highest demands on the speech production mechanism, since the experimental subjects should presumably be more susceptible to breakdown when processing demands are increased. The context predicted to pose the highest demands to the speech production mechanism was L2FR. The reason for

this is that in addition to the increased demands imposed by increasing speech rate, an additional demand is presumably placed on the speech production mechanism by speech production in L2.

As discussed under data processing, for each temporal parameter and each context, the mean duration of the five repetitions of each utterance of each experimental subject was expressed as a percentage of the mean duration of the normal group. This was also done for utterances as a group. The aforementioned procedure made it possible to determine the context in which each experimental subject differed most from the normal group. The data expressing the duration of each temporal parameter of each experimental subject as a percentage of the duration of the normal group for each utterance and utterance group, are displayed in Appendix D.

The results will be described separately for each temporal parameter according to the percentage values obtained for each *utterance group*. The results for the *individual utterances* in an utterance group will only be mentioned if they differ from those for the utterances as a group.

5.3.1 Determination of the context (L1NR, L1FR, L2NR or L2FR) in which each experimental subject differed most from the normal group regarding *vowel duration* of utterances beginning with a *voiceless plosive*

Figure 5.10 provides a graphic presentation of the duration of each experimental subject's VD as a percentage of the VD of the normal group for the voiceless plosive utterance group. The values of one to four, assigned to each context to indicate the magnitude each experimental subject differed from the normal group for the voiceless plosive utterance group are displayed in Table 5.23.

When viewing Figure 5.10, it is evident that all the subjects with AOS, as well as subject PP3, exhibited longer durations than the normal group across all four contexts as indicated by the positive percentage values which were obtained. Subject AOS1, for example, exhibited a mean VD which was 13.6% longer than that of the normal group in the L1NR context and a mean VD which was 42.8% longer than that of the normal group in the L1FR context. AOS1 differed most from the normal group in

L1FR and least in L1NR. A value of one was thus assigned to the L1FR context and a value of four to the L1NR context of this subject.

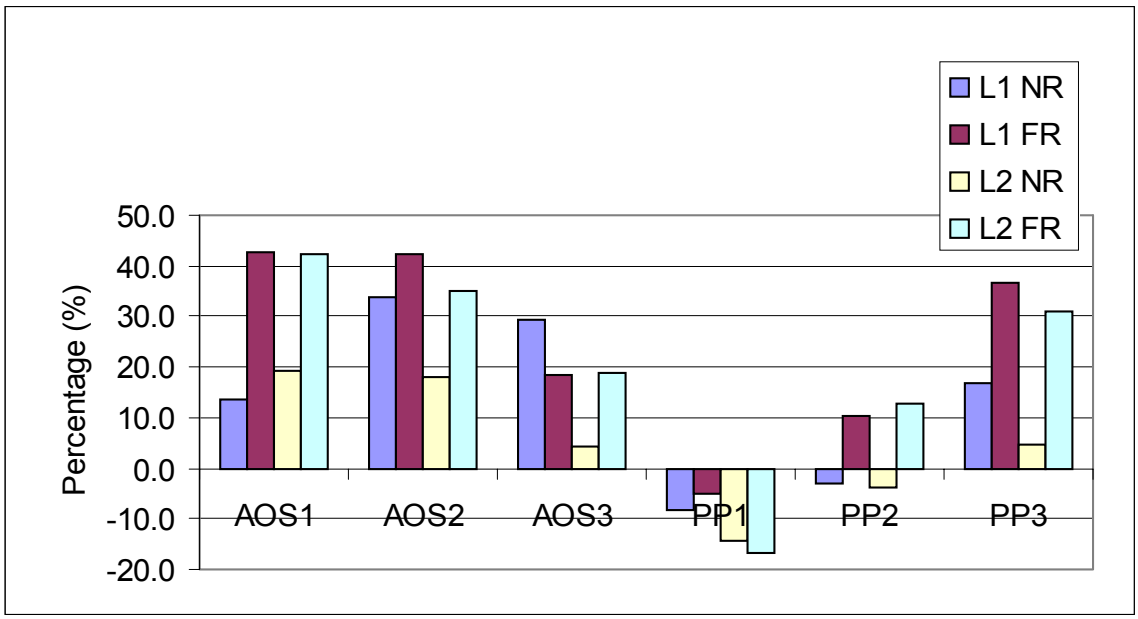

Figure 5.10 Mean vowel duration of each subject expressed as a percentage of the vowel duration of the normal group for each context for the voiceless plosive utterance group

Table 5.23 Assigned values indicating the magnitude of difference between the mean vowel duration of each experimental subject and the normal group for each context for the voiceless plosive utterance group, with a value of one depicting the context where the greatest difference existed and a value of four indicating where the least difference was present

	Value assigned to each context				Context where the subject differed the most from the normal group
	L1NR	L1FR	L2NR	L2FR	
AOS1	4	1	3	2	L1FR
AOS2	3	1	4	2	L1FR
AOS3	1	3	4	2	L1NR
PP1	2*	1*	3*	4*	L1FR
PP2	3*	2	4*	1	L2FR
PP3	3	1	4	2	L1FR

An asterisk (*) indicates that the mean duration of the subject was shorter than the mean duration of the normal group and that a negative percentage value was thus obtained.

From Table 5.23 it can be seen that for the voiceless plosive utterance group, a trend was not evident regarding the greatest difference between the experimental subjects and the normal group occurring in L2FR (with the exception of subject PP2). When viewing the results of the assigned values for the individual utterances (Appendix E), a trend could be observed, however, in that AOS1, PP2 and PP3 exhibited the largest

percentage of utterances which were assigned a value of one in L2FR. Furthermore, AOS2 exhibited an equal number of utterances assigned a value of one in L1FR and L2FR, implying that both these two contexts presumably posed an equal demand to the speech mechanism of this subject.

Regarding the utterance group data (Table 5.23), it is evident that in the NR in both L1 and L2, subject PP2 exhibited shorter durations than the normal group, as indicated by the asterisk, whereas PP1 exhibited shorter durations than the normal group across all four contexts. These two subjects thus exhibited shorter VDs than the normal group in these contexts.

In AOS1, AOS2, PP2 and PP3 the FR context in each language always led to a greater difference from the normal group than the NR. This indicates that the NR context presumably places fewer demands on the speech mechanisms of these subjects compared to the FR context.

5.3.2 Determination of the context (L1NR, L1FR, L2NR or L2FR) in which each experimental subject differed most from the normal group regarding *vowel duration* of utterances beginning with a *voiced plosive*

Figure 5.11 provides a visual presentation of the results depicting the difference between the mean VD of each experimental subject and the normal group, expressed as a percentage, for the voiced plosive utterance group. The values assigned to each context indicating the magnitude of difference between each experimental subject and the normal group are displayed in Table 5.24.

From Figure 5.11 it is evident that all subjects with AOS, as well as subject PP3 displayed longer durations than the normal group across all four contexts. This result is similar to the result reported for the voiceless plosive utterance group. The percentage values of the subjects with AOS ranged from 5.8% (AOS1 for L1NR) to 46.9% (AOS3 for L1NR) and for the subjects with PP from –6.9% (PP2 for L2NR) to 25.3% (PP3 for L2FR). From these values it is evident that the subjects with AOS generally differed more from the normal group than the subjects with PP.

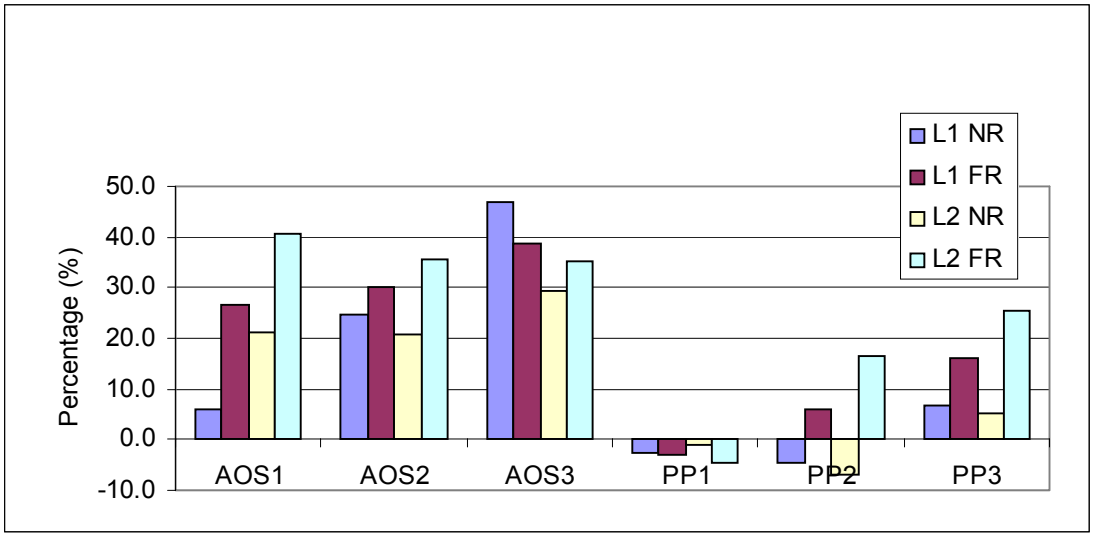

Figure 5.11 Mean vowel duration of each subject expressed as a percentage of the vowel duration of the normal group for each context for the voiced plosive utterance group

Table 5.24 Assigned values indicating the magnitude of difference between the mean vowel duration of each experimental subject and the normal group for each context for the voiced plosive utterance group, with a value of one depicting the context where the greatest difference existed and a value of four indicating where the least difference was present

	Value assigned to each context				Context where the subject differed the most from the normal group
	L1NR	L1FR	L2NR	L2FR	
AOS1	4	2	3	1	L2FR
AOS2	3	2	4	1	L2FR
AOS3	1	2	4	3	L1NR
PP1	2*	3*	1*	4*	L2NR*
PP2	3*	2	4*	1	L2FR
PP3	3	2	4	1	L2FR

An asterisk (*) indicates that the mean duration of the subject was shorter than the mean duration of the normal group and that a negative percentage value was thus obtained.

PP1 exhibited shorter durations than the normal group across all four contexts and PP2 exhibited shorter durations than the normal group in L1NR and L2NR respectively. The fact that PP2 exhibited longer durations than the normal group only in the two FR conditions indicates that the language context alone did not result in longer durations than the normal group. Only when speaking rate had to be increased, did thus subject exhibit longer durations than the normal subjects.

For the voiced plosive group, it is evident that subjects AOS1, AOS2, PP2 and PP3 differed most from the normal group in L2FR. The second greatest difference occurred in L1FR for all these subjects, however, and not in L2NR. This would imply

that the L1FR context was presumably more demanding than the L2NR context leading to a greater difference from the normal group occurring in the L1FR context compared to L2NR. It thus appears that speech production in L2 alone (L2NR) for the specific test stimuli, is not sufficient to increase the difference between these subjects (AOS1, AOS2, PP2 and PP3) and the normal group when compared to L1FR. The additional demands, in this case an increase in speaking rate, is thus necessary to lead to greater deviance from the normal group.

There was not a consistent pattern regarding magnitude of difference between the normal group and experimental subjects in L1NR compared to L2NR. It appears that in some subjects L1NR led to greater differences between the normal group and experimental subjects than L2NR and vice versa. This would imply that speaking in L2 at a NR is not necessarily more difficult for these subjects than speaking in L1NR for the test stimuli used in the present study.

For individual utterances in the voiceless plosive utterance group, the percentage of utterances assigned a value of one was in agreement with the findings for utterances as a group in that AOS1, AOS2, PP2 and PP3 exhibited the greatest percentage of utterances assigned a value of one in L2FR. The only difference which was evident when viewing the data of individual utterances (Appendix E) was for AOS3 who had an equal percentage of utterances assigned a value of one in L1NR and L2FR, whereas the utterance group data only indicated L1NR as the context where this subject differed most from the normal group.

5.3.3 Determination of the context (L1NR, L1FR, L2NR or L2FR) in which each experimental subject differed most from the normal group regarding *vowel duration* of utterances beginning with a *voiceless fricative*

The percentage values depicting the difference between the mean VDs of each experimental subject and the normal group for each context for the voiceless fricative utterance group are displayed in Figure 5.12. From Figure 5.12 it is evident that all subjects with AOS, as well as PP2 and PP3 exhibited longer durations than normal group across all four contexts. This result is similar to that found for the voiced and voiceless plosive utterances groups with the exception of PP2 who did not display

longer mean durations than the normal group across all four contexts for the voiceless and voiced plosive utterance groups.

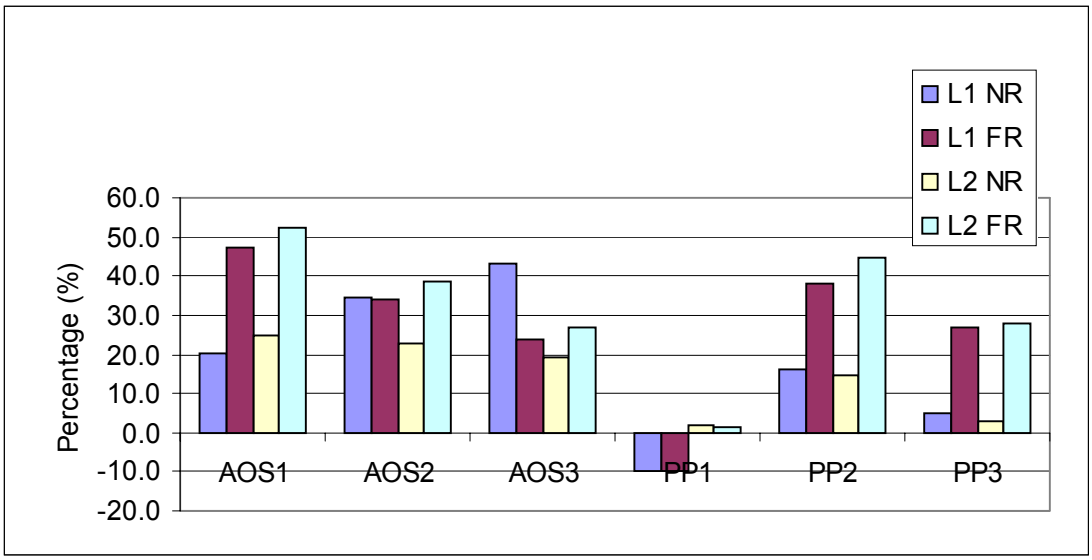

Figure 5.12 Mean vowel duration of each subject expressed as a percentage of the vowel duration of the normal group for each context for the voiceless fricative utterance group

The mean VDs of the subjects with AOS appear to be longer than those of the subjects with PP. The subjects with AOS had durations which were from 19.1% (AOS3 for L2NR) to 52.6% (AOS1 for L2FR) longer than those of the normal group. The subjects with PP had durations which ranged from 9.6% (PP1 for L1NR and L2FR) shorter than those of the normal group to 44.6% (PP2 for L2FR) longer than those of the normal group.

PP1 exhibited shorter durations than the normal group for both L1NR and L1FR, but longer durations for both L2NR and L2FR, implying that L2 led to longer durations than the normal group occurring in this subject. Compared to the subjects with AOS, as well as PP2 and PP3, the durations of PP1 differ much less from those of the normal group.

In Table 5.25 the assigned values, indicating the magnitude each experimental subject's mean durations differed from those of the normal group for each context for the voiceless fricative group, are displayed. In Table 5.25, it can be seen that subjects AOS1, AOS2, PP2 and PP3 exhibited the greatest difference from the normal group in

L2FR. In AOS1, PP2 and PP3, L2FR was followed by L1FR regarding the magnitude of difference from the normal group.

Table 5.25 Assigned values indicating the magnitude of difference between the mean vowel duration of each experimental subject and the normal group for each context for the voiceless fricative utterance group, with a value of one depicting the context where the greatest difference existed and a value of four indicating where the least difference was present

	Value assigned to each context				Context where the subject differed the most from the normal group
	L1NR	L1FR	L2NR	L2FR	
AOS1	4	2	3	1	L2FR
AOS2	2	3	4	1	L2FR
AOS3	1	3	4	2	L1NR
PP1	¾*	3/4*	1	2	L2NR
PP2	3	2	4	1	L2FR
PP3	3	2	4	1	L2FR

An asterisk (*) indicates that the mean duration of the subject was shorter than the mean duration of the normal group and that a negative percentage value was thus obtained.

In subject PP1 the greatest difference from the normal group was in L2NR followed by L2FR, whereas shorter durations than the normal group were obtained in L1NR and L1FR. In this subject, the L2 contexts thus led to a greater difference from the normal group compared to the L1 contexts. AOS3 differed the most from the normal group in L1NR. This result was also found for the voiced and voiceless plosive utterance groups for this subject.

When viewing the results of the individual utterances in the voiceless fricative utterance group, the same pattern of results as discussed for the utterances as a group emerged, with the exception of the results for PP1. For the individual utterances, an equal percentage of utterances were assigned a value of one in each context, implying all contexts presumably posed an equal demand to the speech production mechanism of this subject. Neither the L2 nor the faster speaking rate made this subject deviate further from the normal group.

5.3.4 Determination of the context (L1NR, L1FR, L2NR or L2FR) in which each experimental subject differed most from the normal group regarding *utterance duration* of utterances beginning with a *voiceless plosive*

Figure 5.13 displays the UD of each experimental subject expressed as a percentage of the UD of the normal group in each context for the voiceless plosive utterance group. It can be seen in Figure 5.13 that subjects AOS1, AOS2, PP2 and PP3 exhibited longer durations than the normal group across all four contexts. AOS3 only exhibited a greater duration than the normal group in L2FR, whereas PP1 exhibited a longer duration than the normal group in all contexts with the exception of L2NR where a slightly shorter duration (-0.7%) than the normal group was obtained. The durations of AOS3 were only slightly shorter than those of the normal group (9.7% shorter than the normal group for L2NR, 7.5% for L1NR and 1.6% for L2FR).

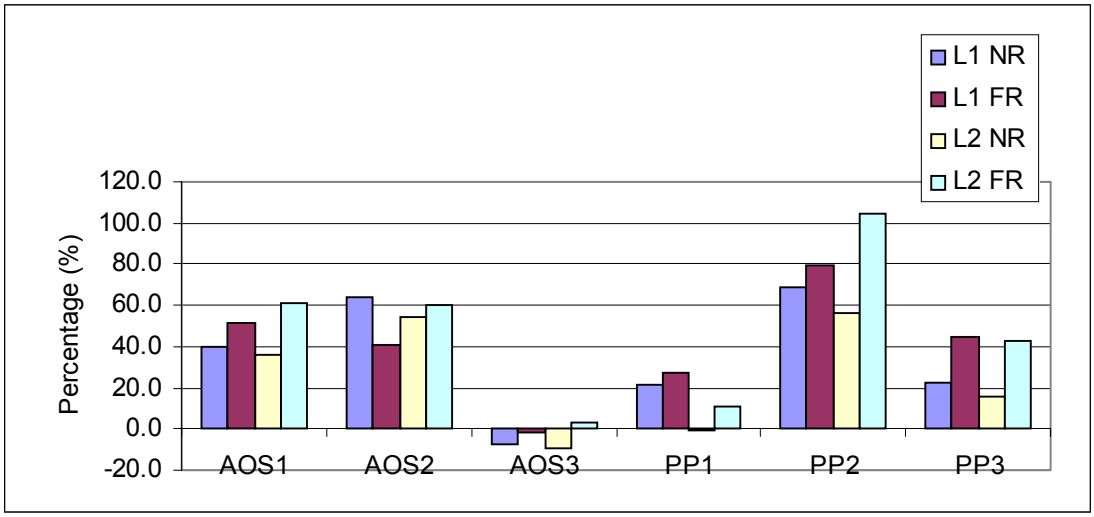

Figure 5.13 Mean utterance duration of each subject expressed as a percentage of the utterance duration of the normal group for the voiceless plosive utterance group

The values which were assigned to indicate the magnitude each subject's mean durations differed from those of the normal group across the four contexts are displayed in Table 5.26.

Table 5.26 Assigned values indicating the magnitude of difference between the mean utterance duration of each subject and the normal group for each context for the voiceless plosive utterance group, with a value of one depicting the context where the greatest difference existed and a value of four indicating where the least difference was present

	Value assigned to each context				Context where the subject differed the most from the normal group
	L1NR	L1FR	L2NR	L2FR	
AOS1	3	2	4	1	L2FR
AOS2	1	4	3	2	L1NR
AOS3	3*	2*	4*	1	L1FR
PP1	2	1	4*	3	L1FR
PP2	3	2	4	1	L2FR
PP3	3	1	4	2	L1FR

An asterisk (*) indicates that the mean duration of the subject was shorter than the mean duration of the normal group and that a negative percentage value was thus obtained.

From Table 5.26 it is evident that AOS1, AOS3 and PP2 exhibited the greatest difference from the normal group in L2FR. For all three these subjects, the greatest difference in L2FR was followed by the L1FR context. The fact that the second greatest difference between the normal group and these three subjects (AOS1, AOS3 and PP2) was in L1FR indicates that the faster rate in L1 is possibly a more demanding context than L2 at a normal speaking rate, since L1FR led to greater deviance from the normal group than L2NR in these subjects.

When the results of the individual utterances are viewed, a different picture emerges for AOS3 and PP3. For AOS3 an equal percentage of utterances in L1NR and L2FR were assigned a value of one, in other words, exhibited the greatest difference from the normal group. Furthermore, for PP3 60% of utterances differed the most from the normal group in L2FR, implying that this context seems to have led to greater deviance from the normal group.

5.3.5 Determination of the context (L1NR, L1FR, L2NR or L2FR) in which each experimental subject differed most from the normal group regarding *utterance duration* of utterances beginning with a *voiced plosive*

The results expressing the mean UD of each experimental subject as a percentage of the mean UD of the normal group for each context for the voiced plosive utterance group are visually displayed in Figure 5.14.

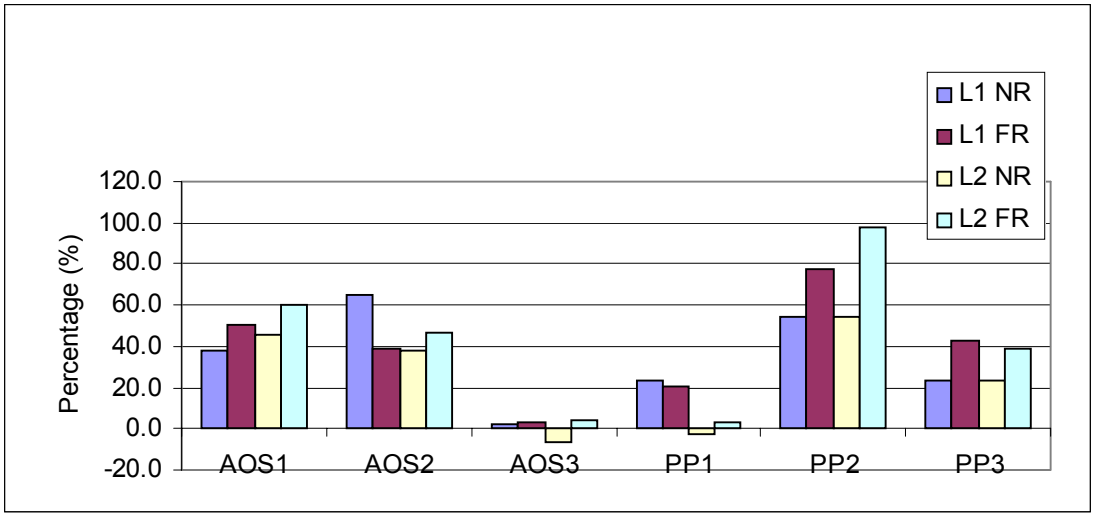

Figure 5.14 Mean utterance duration of each subject expressed as a percentage of the utterance duration of the normal group for the voiced plosive utterance group

From Figure 5.14 it is evident that subjects AOS1, AOS2, PP2 and PP3 displayed longer durations than the normal group across all four contexts. The durations of the experimental subjects ranged from being 2.4% (AOS3 for L1NR) to 98% (PP2 for L2FR) longer than those of the normal group. Both AOS3 and PP1 displayed shorter durations than normal group in L2NR, but longer durations in the other three contexts. In the L2NR context, the duration of AOS3 was 6.7% shorter than that of the normal group and the duration of PP1 was 2.9% shorter than that of the normal group.

In Table 5.27 the values which were assigned to each context to depict the magnitude of difference between the mean duration of each experimental subject and the normal group, are displayed.

Table 5.27 Assigned values indicating the magnitude of difference between the mean utterance duration of each subject and the normal group for each context for the voiced plosive utterance group, with a value of one depicting the context where the greatest difference existed and a value of four indicating where the least difference was present

	Value assigned to each context				Context where the subject differed the most from the normal group
	L1NR	L1FR	L2NR	L2FR	
AOS1	4	2	3	1	L2FR
AOS2	1	3	4	2	L1NR
AOS3	3	2	4*	1	L2FR
PP1	1	2	4*	3	L1NR
PP2	4	2	3	1	L2FR
PP3	3	1	4	2	L1FR

An asterisk (*) indicates that the mean duration of the subject was shorter than the mean duration of the normal group and that a negative percentage value was thus obtained.

From Table 5.27, it is evident that AOS1, AOS3 and PP2 display the greatest difference from the normal group in L2FR, followed by L1FR. There was not a consistent pattern indicating that subjects differed more from the normal group in either L2NR or L1NR.

When viewing the results for the individual utterances, different results from the group data emerged for AOS3 and PP3. For AOS3, instead of L2FR being the context resulting in the greatest difference from the normal group, the individual data indicate that L1NR and L1FR had an equal percentage of utterances assigned a value of one for this subject. For PP3, it was evident that 80% of utterances in the L2FR context were assigned a value of one, indicating that this context appears to have caused the greatest difference from the normal group. The utterance group data of PP3 indicated L1FR as resulting in the greatest difference from the normal group.

5.3.6 Determination of the context (L1NR, L1FR, L2NR or L2FR) in which each experimental subject differed most from the normal group regarding *utterance duration* of utterances beginning with a *voiceless fricative*

The results for the voiceless fricative utterance group are displayed in Figure 5.15.

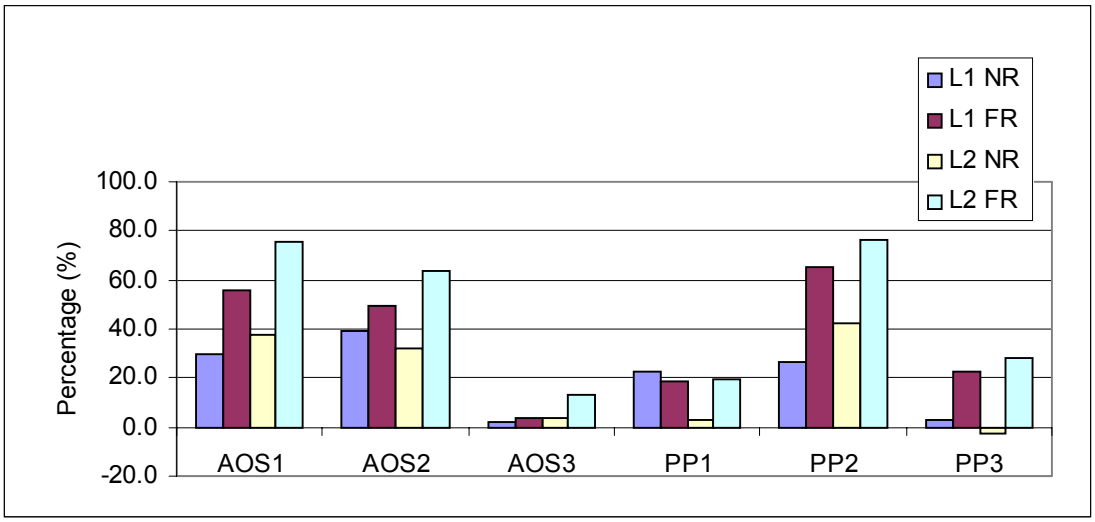

Figure 5.15 Mean utterance duration of each subject expressed as a percentage of the utterance duration of the normal group for the voiceless fricative utterance group

It can be seen in Figure 5.15 that all subjects with the exception of PP3 in L2NR displayed longer mean durations than the normal group across all four contexts.

Subject AOS3 had only slightly longer durations than the normal group compared to the other subjects, however, with durations which were from 2.4% to 13.5% longer than those of the normal group. The other experimental subjects exhibited durations which were from 2.8% (PP3 for L1NR) to 76.4% (PP2 for L2FR) longer than those of the normal group.

In Table 5.28 the assigned values, indicating the magnitude each subject's mean durations differed from the normal group for each context for the voiceless fricative group, are displayed. It is evident from Table 5.28 that all subjects, with the exception of PP1, exhibited the greatest difference from the normal group in L2FR. In all of the subjects exhibiting the greatest difference in L2FR, with the exception of AOS3, the second greatest difference was in L1FR.

Table 5.28 Assigned values indicating the magnitude of difference between the mean utterance duration of each experimental subject and the normal group for each context for the voiceless fricative utterance group, with a value of one depicting the context where the greatest difference existed and a value of four indicating where the least difference was present

	Value assigned to each context				Context where the subject differed the most from the normal group
	L1NR	L1FR	L2NR	L2FR	
AOS1	4	2	3	1	L2FR
AOS2	3	2	4	1	L2FR
AOS3	4	3	2	1	L2FR
PP1	1	3	4	2	L1NR
PP2	4	2	3	1	L2FR
PP3	3	2	4*	1	L2FR

An asterisk (*) indicates that the mean duration of the subject was shorter than the mean duration of the normal group and that a negative percentage value was thus obtained.

When viewing the individual utterances, slightly different results were evident for AOS2 and PP1. For both PP1 and AOS2, an equal percentage of utterances were assigned a value of one for L1NR and L2FR. The results of AOS2 and PP1 indicate that both these contexts (L1NR and L2FR) equally affected durations to deviate from those of the normal group.

5.3.7 Determination of the context (L1NR, L1FR, L2NR or L2FR) in which each experimental subject differed most from the normal group regarding *utterance onset duration* of utterances beginning with a *voiceless plosive*

Figure 5.16 provides a visual display of the results for sub-aim two of each experimental subject and the normal group for each context for the voiceless plosive utterance group.

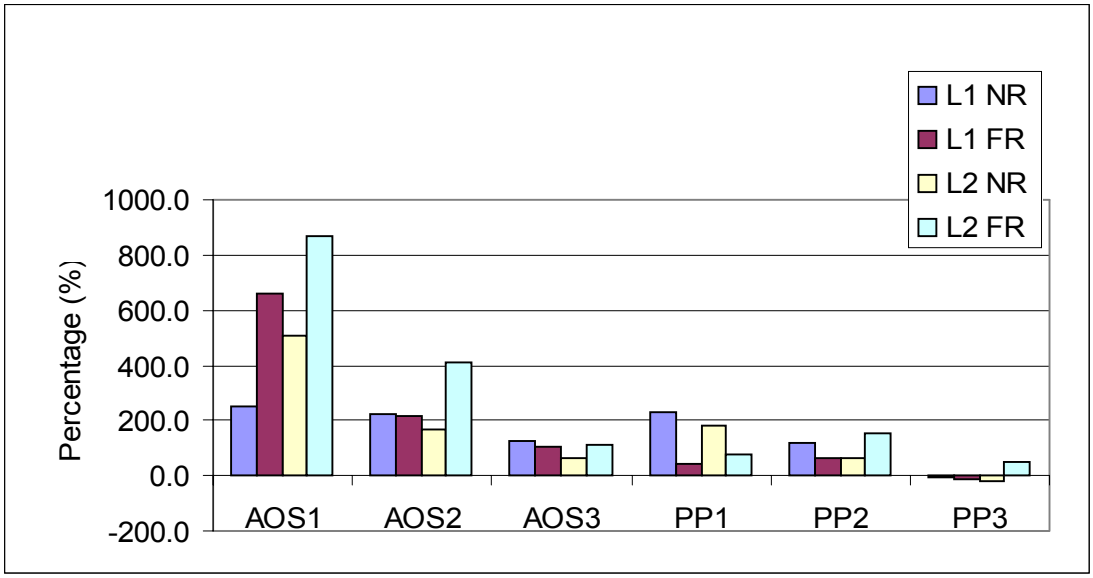

Figure 5.16 Mean utterance onset duration of each subject expressed as a percentage of the of utterance onset duration of the normal group for the voiceless plosive utterance group

From Figure 5.16 it is evident that all subjects, with the exception of PP3, displayed longer durations than the normal group across all four contexts. PP3 only displayed a longer mean duration than the normal group in L2FR and slightly shorter durations than the normal group in the other three contexts. It is evident that the UODs of AOS1 are the longest, with UODs being from 253.6% (in L1NR) to 865.2% (in L2FR) longer than those of the normal group.

Table 5.29 provides a summary of the assigned values indicating the magnitude of difference between the durations of each experimental subject and those of the normal group in each context. From Table 5.29 it is evident that subjects AOS1, AOS2, PP2 and PP3 differed most from the normal group regarding their durations in L2FR. In AOS1, the greatest difference in L2FR was followed by L1FR implying that speaking in L1 in the FR was presumably more difficult than speaking at a NR in L2.

Table 5.29 Assigned values indicating the magnitude of difference between the mean utterance onset duration of each experimental subject and the normal group for each context for the voiceless plosive utterance group, with a value of one depicting the context where the greatest difference existed and a value of four indicating where the least difference was present

	Value assigned to each context				Context where the subject differed the most from the normal group
	L1NR	L1FR	L2NR	L2FR	
AOS1	4	2	3	1	L2FR
AOS2	2	3	4	1	L2FR
AOS3	1	3	4	2	L1NR
PP1	1	4	2	3	L1NR
PP2	2	3	4	1	L2FR
PP3	2*	3*	4*	1	L2FR

An asterisk (*) indicates that the mean duration of the subject was shorter than the mean duration of the normal group and that a negative percentage value was thus obtained.

Both AOS2 and PP2 exhibited the second greatest difference from the normal group in L1NR. This result is difficult to explain, but it could be indicative of the inconsistency in performance in subjects with AOS and that this inconsistency across speech tasks is also exhibited by persons with PP. Both AOS3 and PP1 exhibited the greatest difference from the normal group in L1NR condition.

When viewing individual utterances, the same results as for the utterances as a group emerged for subjects AOS1, AOS2, PP2 and PP3 in that the largest percentage of utterances which were assigned a value of one was also in the L2FR context.

5.3.8 Determination of the context (L1NR, L1FR, L2NR or L2FR) in which each experimental subject differed most from the normal group regarding *utterance onset duration* of utterances beginning with a *voiced plosive*

The reader is referred to Figure 5.17 for a graphic presentation of results displaying the mean UODs of each experimental subject as a percentage of the mean UODs of the normal group for each context for the voiced plosive utterance group. From Figure 5.17 it can be seen that all subjects, with the exception of PP3, exhibited longer durations than the normal group across all four contexts. PP3 only exhibited a longer duration than the normal group in L1NR and L2FR and a slightly shorter duration than the normal group in L1FR (-2.9%) and L2NR (-1.2%). Subject AOS1 had the longest durations which were from 606.4% (L1NR) to 1429.2% (L2FR) longer than the durations of the normal group.

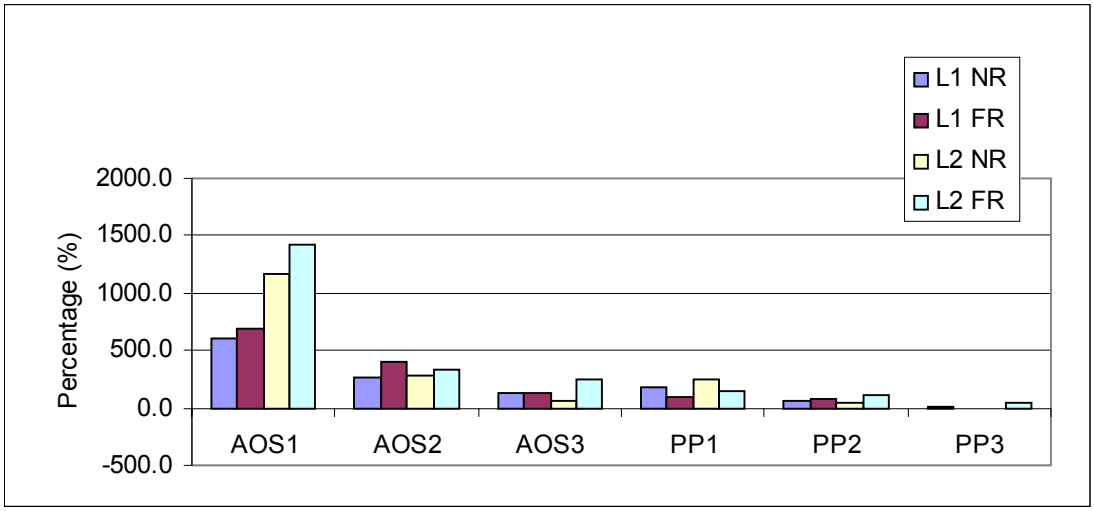

Figure 5.17 Mean utterance onset duration of each subject expressed as a percentage of the utterance onset duration of the normal group for the voiced plosive utterance group

In Table 5.30 a summary of the assigned values indicating the magnitude of difference between the durations of each experimental subject and the normal group in each context is provided.

Table 5.30 Assigned values indicating the magnitude of difference between the mean utterance onset duration of each experimental subject and the normal group for each context for the voiced plosive utterance group, with a value of one depicting the context where the greatest difference existed and a value of four indicating where the least difference was present

	Value assigned to each context				Context where the subject differed the most from the normal group
	L1NR	L1FR	L2NR	L2FR	
AOS1	4	3	2	1	L2FR
AOS2	4	1	3	2	L1FR
AOS3	2	3	4	1	L2FR
PP1	2	4	1	3	L2NR
PP2	3	2	4	1	L2FR
PP3	2	4*	3*	1	L2FR

An asterisk (*) indicates that the mean duration of the subject was shorter than the mean duration of the normal group and that a negative percentage value was thus obtained.

In Table 5.30 it can be seen that AOS1, AOS3, PP2 and PP3 exhibited the greatest difference from the normal group in L2FR. The context where the second greatest difference occurred for these subjects varied with no specific trend emerging.

When viewing the results of the individual utterances in the voiced plosive utterance group, a slightly different result emerged for AOS1 and PP2. For both these subjects

the utterance group data indicated that the greatest difference from the normal group was in L2FR. However, for the individual utterances AOS1 had an equal percentage of utterances assigned a value of one for L2NR and L2FR and PP2 exhibited an equal percentage of utterances assigned a value of one for L1FR and L2FR.

5.3.9 Determination of the context (L1NR, L1FR, L2NR or L2FR) in which each experimental subject differed most from the normal group regarding *voice onset time* of utterances beginning with a *voiceless plosive*

Figure 5.18 displays the results regarding the extent each subject's VOTs differed from those of the normal group in each context for the voiceless plosive utterance group.

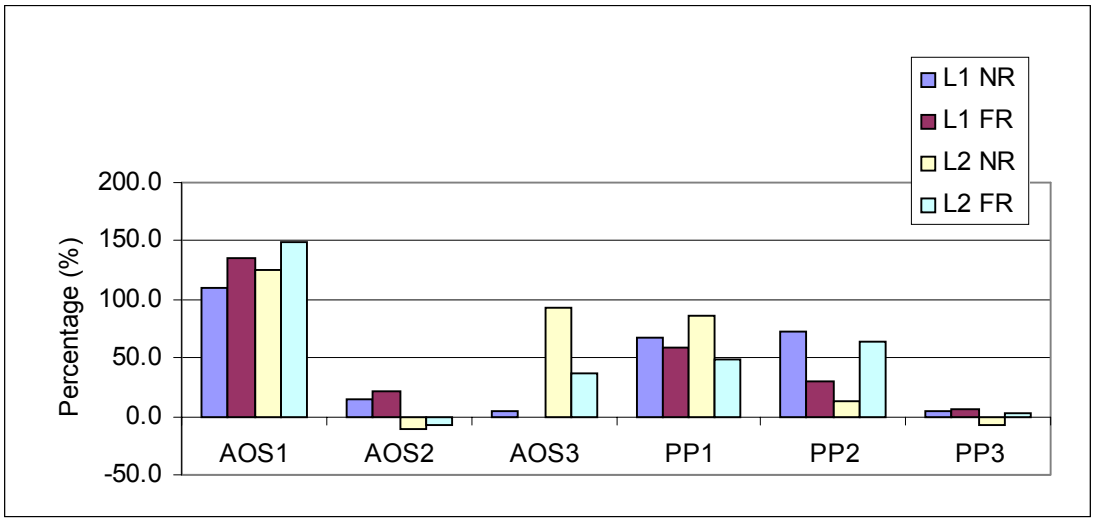

Figure 5.18 Mean voice onset time of each subject expressed as a percentage of the voice onset time of the normal group for the voiceless plosive utterance group

From Figure 5.18 it is evident that AOS1, PP1 and PP2 exhibited longer mean VOT durations than the normal speakers across all four contexts. AOS2 exhibited shorter durations than the normal group in L2NR (–11.3%) and L2FR (-7.5%), whereas AOS3 exhibited a slightly shorter duration (-0.7%) than the normal group in L1FR. PP3 also exhibited a shorter duration than the normal group for L2NR (–6.8%). AOS1, who had the most severe AOS, exhibited durations which were 109.1% (for L1NR) to 149.7% (L2FR) longer than those of the normal group. The durations of the other experimental subjects did not differ from those of the normal group to the same

extent as those of AOS1 and were from 3.3% to 92.4% longer than those of the normal group.

Regarding the context in which the greatest difference between the durations of each experimental subject and those of the normal group existed, the reader is referred to Table 5.31.

Table 5.31 Assigned values indicating the magnitude of difference between the mean voice onset time duration of each experimental subject and the normal group for each context for the voiceless plosive utterance group, with a value of one depicting the context where the greatest difference existed and a value of four indicating where the least difference was present

	Value assigned to each context				Context where the subject differed the most from the normal group
	L1NR	L1FR	L2NR	L2FR	
AOS1	4	2	3	1	L2FR
AOS2	2	1	4*	3*	L1FR
AOS3	3	4*	1	2	L2NR
PP1	2	3	1	4	L2NR
PP2	1	3	4	2	L1NR
PP3	2	1	4*	3	L1FR

An asterisk (*) indicates that the mean duration of the subject was shorter than the mean duration of the normal group and that a negative percentage value was thus obtained.

From Table 5.31 it can be seen that only AOS1 differed most from the normal group in L2FR followed by L1FR. AOS3 exhibited the greatest difference from the normal group in L2NR followed by L2FR, indicating that the L2 context contributed to the deviation from the normal group, although the prediction of L2FR resulting in the greatest deviation from the normal group was not verified. PP1 also exhibited the greatest difference from the normal group in L2NR, although the least difference occurred in L2FR.

When the results of the individual utterances are viewed, a different result emerged for PP3, in that both the L1NR and L2FR had an equal number of utterances assigned a value of one, whereas the utterance group data indicated that this subject differed the most from the normal group only in L2FR.

5.3.10 Summary of results for sub-aim two

In order to consolidate and summarize the findings related to sub-aim two, Table 5.32 was compiled. In this table it is indicated whether the hypothesis that the L2FR context would result in subjects deviating most from the normal group, was verified. If a subject differed most from the normal group in L2FR for either the utterance group (behavior A) or the largest number of individual utterances in the utterance group (behavior B), an X is indicated in the table. From Table 5.32, it is possible to determine whether a trend existed for each experimental subject regarding deviating most from the normal group in L2FR. The results regarding the abovementioned prediction are provided for utterances as a group and for individual utterances in an utterance group respectively, for each temporal parameter. It is also indicated in Table 5.32 if a subject exhibited longer durations than the normal group across all four contexts (behavior C).

From Table 5.32 it is evident that regarding VD, UD and UOD, subjects AOS1, PP2 and PP3 appear to exhibit a trend of the greatest deviation from the normal group occurring in L2FR. AOS2 also exhibited this trend for all utterance groups regarding VD. Regarding UD, the durations of AOS2 differed most from the normal group in L2FR only for the fricative utterance group and regarding UOD only for the voiceless plosive group. AOS3 also exhibited the trend of differing most from the normal group in L2FR, but to a lesser degree. Regarding VD, subject AOS3 differed most from the normal group equally in L1NR and L2FR for the voiced plosive utterance group, although this trend was exhibited for all utterance groups regarding UD and for the voiced plosive group regarding UOD. PP1 does not appear to differ most from the normal group in L2FR at all, with the exception of the voiceless fricative utterance group regarding UD, where an equal difference from the normal group occurred in L1NR and L2FR.

Table 5.32 Summarized findings for sub-aim two indicating whether the durations of each experimental subject differed most from those of the normal group in the L2FR context regarding each temporal parameter for utterances as a group and for individual utterances of each utterance group

	Utterance group	Finding	AOS1	AOS2	AOS3	PP1	PP2	PP3
Vowel duration	**Voiceless Plosives**							
	Utterances as a group	A					X	
	Individual utterances	B	X	L1FR & L2FR			X	X
		C	X	X	X			X
	Voiced Plosives							
	Utterances as a group	A	X	X			X	X
	Individual utterances	B	X	X	L1NR & L2FR		X	X
		C	X	X	X			X
	Voiceless Fricatives							
	Utterances as a group	A	X	X			X	X
	Individual utterances	B	X	X		All contexts equal	X	L1FR & L2FR
		C	X	X	X		X	X
Utterance duration	**Voiceless Plosives**							
	Utterances as a group	A	X		X		X	
	Individual utterances	B	X		L1NR & L2FR		X	X
		C	X	X			X	X
	Voiced Plosives							
	Utterances as a group	A	X		X		X	
	Individual utterances	B	X				X	X
		C	X	X			X	X
	Voiceless Fricatives							
	Utterances as a group	A	X	X	X		X	X
	Individual utterances	B	X	L1NR & L2FR	X	L1NR & L2FR	X	X
		C	X	X	X	X	X	
Utterance onset duration	**Voiceless Plosives**							
	Utterances as a group	A	X	X			X	X
	Individual utterances	B	X	X			X	X
		C	X	X	X	X	X	
	Voiced Plosives							
	Utterances as a group	A	X		X		X	X
	Individual utterances	B	L2NR & L2FR		X		L1FR & L2FR	X
		C	X	X	X	X	X	
VOT	**Voiceless Plosives**							
	Utterances as a group	A	X					
	Individual utterances	B	X					L1NR & L2FR
		C	X			X	X	

A=The duration of the experimental subject differed most from the duration of the normal group in L2FR.
B=L2FR had the largest percentage of utterances where the duration of the experimental subject differed most from that of the normal group.
C=The duration of the experimental subject was greater than that of the normal group across all four contexts.
An X is indicated if the finding is present. In instances where more than one context rendered the same result, both these contexts are cited.

5.4 RESULTS FOR SUB-AIM THREE: DETERMINATION OF THE CONTEXT (L1NR, L1FR, L2NR AND L2FR) IN WHICH VARIABILITY OF EACH SUBJECT IS THE GREATEST

The objective of sub-aim three was to determine for each subject, in which of the four contexts variability was generally the greatest regarding each temporal parameter. It was predicted that the greatest variability would occur in L2FR, since this context was hypothesized to pose the greatest demands to the speech production mechanism. It was further hypothesized that greater processing demands would result in greater variability for persons with compromised speech production systems, since their speech mechanisms would presumably be more "unstable" when processing demands were increased.

As discussed in chapter four, variability of duration was determined by calculating the SD of the five repetitions of each utterance for each subject and the normal group for each context. For each target utterance of each subject and the normal group, a number from one to four was then assigned to the SD in each context, in an attempt to rank the SDs from smallest to largest. The tables for each temporal parameter and target utterance of each utterance group displaying the assigned values of one to four to the SDs of the four contexts are displayed in Appendix F.

For each utterance group the percentage of utterances which were assigned a value of one was then calculated for each context. These percentage values were then tabulated and it was indicated in which context the largest percentage of utterances were assigned a value of one (Tables 5.33 to 5.42). From these results it was possible to determine if the largest percentage of utterances where the SD was the greatest, generally occurred in either, L2NR or L2FR. If a trend existed that the largest percentage of utterances assigned a value of one was in either L2NR or L2FR, it could be argued that the speech motor system was more "unstable" or "unreliable" in these contexts, and consequently that these contexts posed higher demands to the speech production mechanism.

In addition to determining the context where the SD was generally the greatest for most utterances in an utterances group, it was determined for each experimental subject within each context, if their SDs were greater than those of the normal group regarding each utterance group of each temporal parameter. The latter was done by

expressing each subject's SD as a percentage of the SD of the normal group for each utterance. From these values a mean percentage value was then calculated for each utterance group. The percentage values expressing the SDs of each pathologic subject as a percentage of the SD of the normal group for each temporal parameter and utterance group are displayed in Appendix G. The results for each temporal parameter and utterance group are discussed separately. At the end of the discussion, a table is provided (Table 5.43) with summarized findings for sub-aim three to determine whether a trend existed regarding variability generally being the greatest in the L2NR or L2FR context.

5.4.1 Determination of the context (L1NR, L1FR, L2NR and L2FR) in which *variability* of each subject is the greatest for *vowel duration* of utterances beginning with a *voiceless plosive*

Table 5.33 displays the percentage of utterances in each context for the voiceless plosive utterance group which were assigned a value of one, in other words, that exhibited the greatest SDs.

Table 5.33 The percentage of utterances in each context in the voiceless plosive utterance group which were assigned a value of one indicating the context where variability was the greatest for most utterances regarding VD

	L1NR (%)	L1FR (%)	L2NR (%)	L2FR (%)	The context with the largest percentage of utterances displaying the greatest SD
AOS1	0	20	40	40	L2NR and L2FR
AOS2	0	40	20	40	L1FR and L2FR
AOS3	40	20	20	20	L1NR
N1	20	0	40	40	L2NR and L2FR
N2	40	20	40	0	L1NR and L2NR
N3	20	40	0	40	L1FR and L2FR
N4	20	20	40	20	L2NR
N5	80	0	0	20	L1NR
NGR	20	0	40	40	L2NR and L2FR
PP1	20	0	80	0	L2NR
PP2	20	0	40	40	L2FR and L2NR
PP3	0	60	0	40	L1FR

From Table 5.33 it can be seen that for the normal group, both L2NR and L2FR, had 40% of utterances assigned a value of one. This result indicates that speech production in the L2 context (L2NR and L2FR) resulted in more variable production on repeated trials of a specific utterance. When the results of individual speakers in

the normal group are viewed, it is evident that the context with the greatest variability differed amongst speakers and it does not appear that the L2NR or L2FR context consistently led to greater variability. For example, N5 exhibited the greatest variability for 80% of the utterances in the voiceless plosive utterance group in L1NR.

The subjects with AOS also did not show a consistent pattern regarding the greatest variability occurring predominantly in a specific context. AOS1 exhibited an equal percentage of utterances where variability was the greatest in L2NR and L2FR (40% of utterances in each context), indicating that the L2 contexts led to greater variability in this subject than the L1 contexts. AOS2, on the other hand, exhibited an equal percentage of utterances where variability was the greatest in L1FR and L2FR (40% of utterances in each context). This indicates that the FR conditions led to greater variability in this subject. AOS3 had the largest percentage of utterances with the greatest variability in L1NR (40% of utterances), whereas the other three contexts each had one utterance (20% of utterances) where the greatest variability occurred. For this subject, L1NR thus appears to have resulted in the greatest variability.

In PP1, 80% of utterances displayed the greatest variability in the L2NR context. The increased rate did not seem to affect variability of production in this subject, possibly implying that this person's speech production is more consistent when speaking at a faster than normal rate. PP2 fared similar to the normal group in that 40% of utterances in both L2NR and L2FR exhibited the greatest variability, indicating that L2 contexts led to greater variability in this subject. In PP3, 60% of utterances exhibited the greatest variability in L1FR and 40% of utterances in L2FR. This result implies that the FR in both languages led to greater variability.

In Figure 5.19 the SDs of each experimental subject are expressed as a percentage of the SDs of the normal group. A positive percentage value indicates that the SD of the experimental subject was larger than that of the normal group, whereas a negative percentage value indicates that the SD of the subject was shorter than that of the normal group.

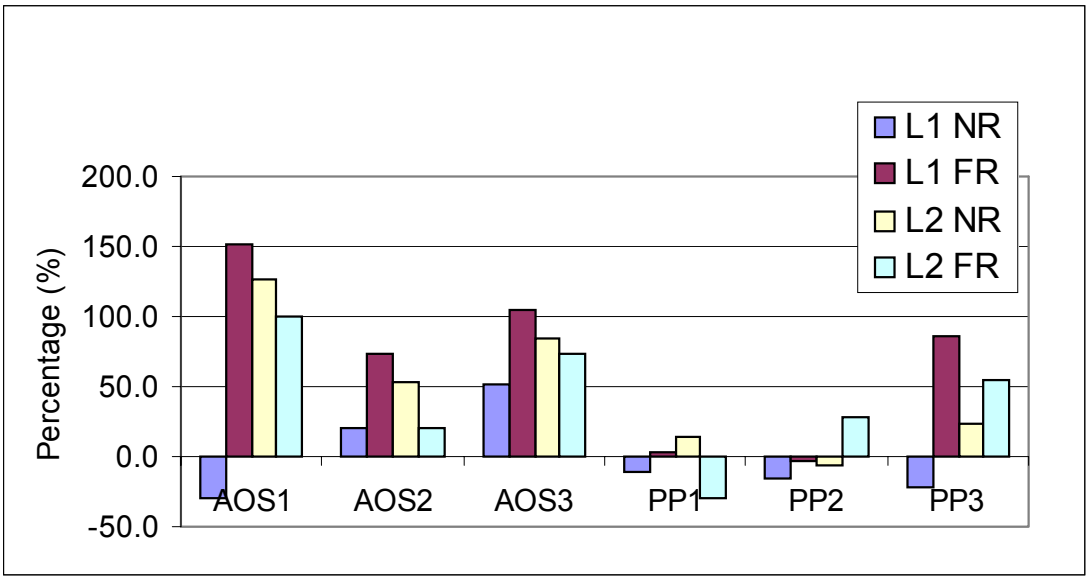

Figure 5.19 The SDs of vowel duration of each subject expressed as a percentage of the SD of the normal group for each context for the voiceless plosive utterance group

From Figure 5.19 it is evident that AOS2 and AOS3 exhibited greater SDs than the normal group across all four contexts, whereas AOS1 had greater SDs than the normal group in all contexts except L1NR. The SDs of the subjects with AOS ranged from being 30% shorter (AOS1 for L1NR) than those of the normal group to being 151.7% longer (AOS1 for L1FR). PP3 also exhibited greater SDs than the normal group in all contexts except the L1NR context where the SD of this subject was 22.5% smaller than that of the normal group. PP1 had greater SDs than the normal group only in L1FR and L2NR, whereas PP2 had a greater SD than the normal group only in L2FR. The subjects with AOS generally had greater SDs than the subjects with PP, especially PP1 and PP2. The SDs of PP1 and PP2 appear to be more comparable to the SDs of the normal group and were often slightly shorter than those of the normal group.

5.4.2 Determination of the context (L1NR, L1FR, L2NR and L2FR) in which *variability* of each subject is the greatest for *vowel duration* of utterances beginning with a *voiced plosive*

The results regarding the percentage of utterances, beginning with a voiced plosive, which exhibited the greatest variability in each context, are displayed in Table 5.34.

Table 5.34 The percentage of utterances in each context in the voiced plosive utterance group which were assigned a value of one indicating the

context where variability was the greatest for most utterances regarding VD

	L1NR (%)	L1FR (%)	L2NR (%)	L2FR (%)	The context with the largest percentage of utterances displaying the greatest SD
AOS1	0	20	20	60	L2FR
AOS2	40	40	20	0	L1NR and L1FR
AOS3	20	40	20	20	L1FR
N1	0	0	60	40	L2NR
N2	20	20	40	20	L2NR
N3	20	0	0	80	L2FR
N4	40	20	0	40	L1NR and L2FR
N5	40	0	0	60	L2FR
NGR	20	0	20	60	L2FR
PP1	60	0	20	20	L1NR
PP2	20	0	20	60	L2FR
PP3	60	20	20	0	L1NR

From Table 5.34, it is evident that subjects AOS1, PP2 and the normal group exhibited the largest percentage of utterances (60%) with the greatest variability in L2FR, indicating that this context generally led to greater variability in the speech of these subjects. The L2 context, together with the increased demand of increasing rate, thus resulted in greater token-to-token variability. The individual normal speakers exhibited the largest percentage of utterances with the greatest variability in either L2NR or L2FR. AOS2 had 40% of utterances in both L1NR and L1FR which exhibited the greatest variability. Both PP1 and PP3 exhibited 60% of utterances with the greatest variability in L1NR.

All the experimental subjects exhibited greater SDs than the normal group across all four contexts as is evident from Figure 5.20.

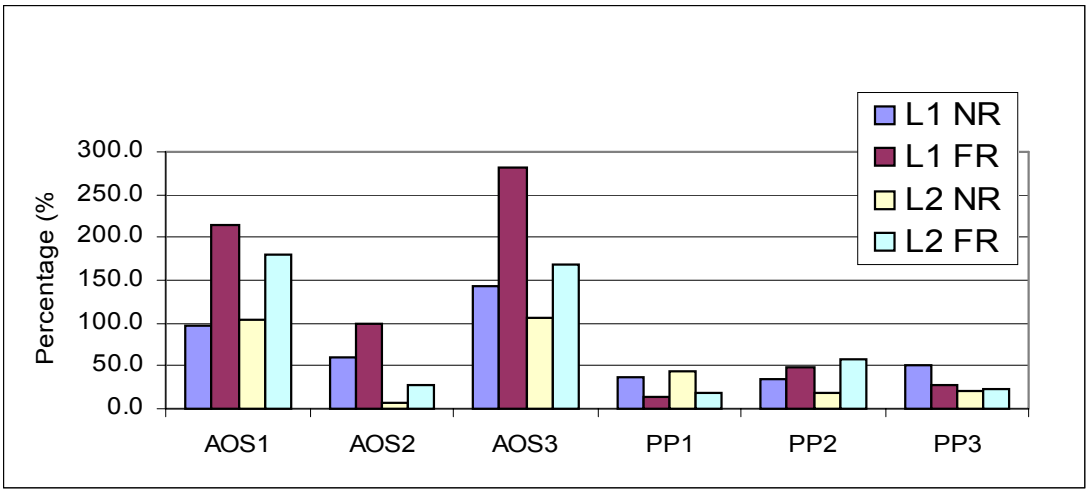

Figure 5.20 The SDs of vowel duration of each subject expressed as a percentage of the SD of the normal group for each context for the voiced plosive utterance group

From Figure 5.20 it is further evident that the subjects with AOS generally had greater SDs than the subjects with PP, with the exception of AOS2 in L2NR. The SDs of the

subjects with AOS were between 6.7% (AOS2 for L2NR) and 280.4% (AOS2 for L1FR) greater than those of the normal group. The subjects with PP displayed SDs which were between 13.5% (PP1 for L1FR) and 57.1% (PP2 for L2FR) greater than those of the normal group.

5.4.3 Determination of the context (L1NR, L1FR, L2NR and L2FR) in which *variability* of each subject is the greatest for *vowel duration* of utterances beginning with a *voiceless fricative*

The results regarding the percentage of utterances beginning with a voiceless fricative that exhibited the greatest variability in each context are displayed in Table 5.35. From this table it is evident that subjects AOS1, AOS2, PP2 and the normal group exhibited the largest percentage of utterances with the greatest SD in L2NR.

Table 5.35 The percentage of utterances in each context in the voiceless fricative utterance group which were assigned a value of one indicating the context where variability was the greatest for most utterances regarding VD

	L1NR (%)	L1FR (%)	L2NR (%)	L2FR (%)	The context with the largest percentage of utterances displaying the greatest SD
AOS1	25	25	50	0	L2NR
AOS2	0	25	50	25	L2NR
AOS3	25	50	25	0	L1FR
N1	0	25	75	0	L2NR
N2	25	25	50	0	L2NR
N3	0	0	25	75	L2FR
N4	25	0	25	50	L2FR
N5	100	0	0	0	L1NR
NGR	0	0	75	25	L2NR
PP1	75	0	0	25	L1NR
PP2	25	25	50	0	L2NR
PP3	25	50	0	25	L1FR

The individual normal subjects, with the exception of N5, exhibited the largest percentage of utterances with the greatest variability in either L2NR or L2FR indicating that the L2 contexts led to greater variability than the L1 contexts.

AOS3 exhibited 50% of utterances with the greatest variability in the L1FR context and 25% each in the L1NR and L2NR context. Speech production in the FR in L1 thus led to greater variability in this subject than in the L2FR context. The L2 context thus does not seem to have influenced the accuracy of performance on various trials of a specific utterance in this subject. The other two subjects with PP did not exhibit

the greatest variability in a L2 context, with PP1 exhibiting 75% of utterances with the greatest variability in L1NR and PP3 exhibiting 50% of utterances with the greatest variability in the L1FR context.

Regarding the SDs of the experimental subjects relative to those of the normal group, it is evident from Figure 5.21 that all the subjects with AOS exhibited greater SDs than the comparison group across all four contexts with SD being between 20.1% (AOS3 for L2FR) and 310.8% (AOS1 for L1FR) greater than those of the normal group. The subjects with AOS generally had greater SDs than PP1 and PP3 who occasionally displayed SDs smaller than those of the normal group.

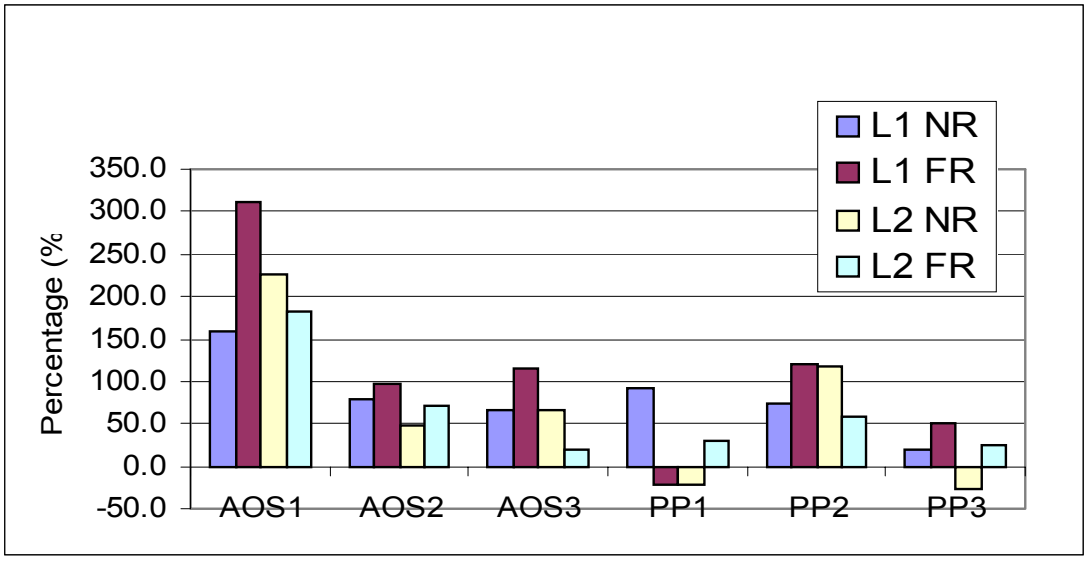

Figure 5.21 The SDs of vowel duration of each subject expressed as a percentage of the SD of the normal group for each context for the voiceless fricative utterance group

5.4.4 Determination of the context (L1NR, L1FR, L2NR and L2FR) in which *variability* of each subject is the greatest for *utterance duration* of utterances beginning with a *voiceless plosive*

The results regarding the percentage of utterances in the voiceless plosive utterance group which exhibited the greatest variability in each context are displayed in Table 5.36.

Table 5.36 The percentage of utterances in each context in the voiceless plosive utterance group which were assigned a value of one indicating the context where variability was the greatest for most utterances regarding UD

	L1NR (%)	L1FR (%)	L2NR (%)	L2FR (%)	The context with the largest percentage of utterances displaying the greatest SD
AOS1	40	20	0	40	L1NR and L2FR
AOS2	0	20	20	60	L2FR
AOS3	20	20	20	40	L2FR
N1	20	20	60	0	L2NR
N2	0	0	20	80	L2FR
N3	0	60	20	20	L1FR
N4	0	20	40	40	L2NR and L2FR
N5	20	20	40	20	L2NR
NGR	0	0	60	40	L2NR
PP1	20	60	0	20	L1FR
PP2	20	40	20	20	L1FR
PP3	20	40	20	20	L1FR

From Table 5.36 it is evident that both AOS2 and AOS3 exhibited most utterances with the greatest variability (largest SDs) in L2FR. AOS1, on the other hand, exhibited an equal percentage of utterances with the greatest variability in L1NR and L2FR.

The normal group exhibited the greatest variability in L2NR indicating that this context led to the greatest variability in these subjects. In the normal group L2FR had the second largest percentage of utterance exhibiting the greatest variability. With an increase in speaking rate, speech production of these subjects thus became less variable. All three subjects with PP appear not to have been influenced by the L2 context regarding an increase in variability in that all three these subjects exhibited the most utterances with the greatest variability in L1FR. The latter result implies that L2 did not increase token-to-token variability in the subjects with PP.

In Figure 5.22 the SDs of each experimental subject are expressed as a percentage of the SDs of the normal group. From Figure 5.22 it is evident that the SDs of the experimental subjects were greater than those of the normal group across all four contexts with the exception of AOS3 for L2NR. However, the SD of AOS3 was only slightly less than that of the normal group in this context (-3.8%). The SDs of the subjects with PP were between 11.7% (PP3 for L2NR) and 140.6% (PP1 for L1FR) greater than those of the normal group, while the SDs of the subjects with AOS were between 32.3% (AOS2 for L1NR) and 221.7% (AOS1 for L1NR) greater than those of the normal group.

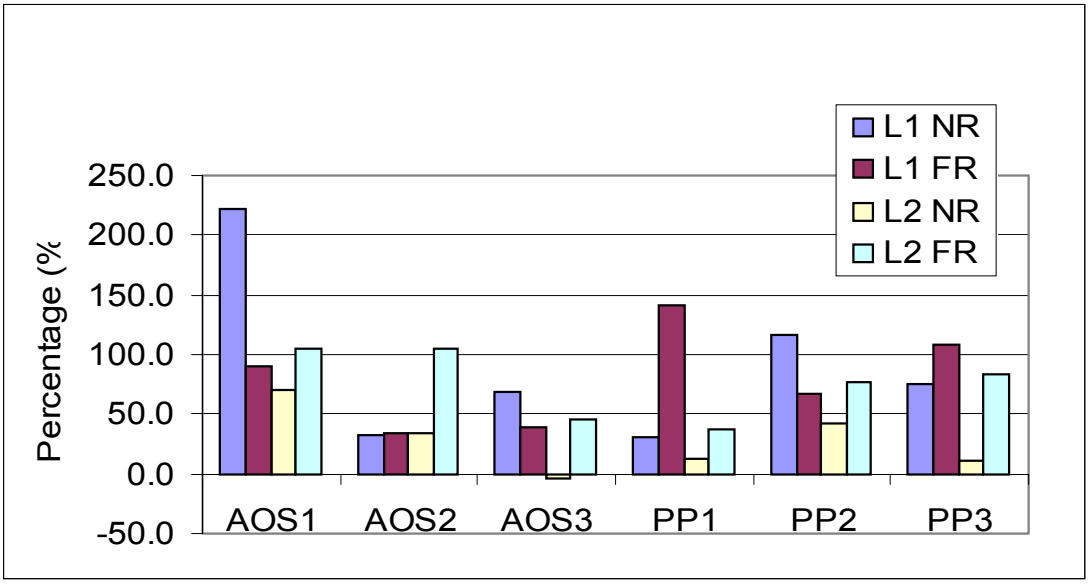

Figure 5.22 The SDs of utterance duration of each subject expressed as a percentage of the SD of the normal group for each context for the voiceless plosive utterance group

5.4.5 Determination of the context (L1NR, L1FR, L2NR and L2FR) in which *variability* of each subject is the greatest for *utterance duration* of utterances beginning with a *voiced plosive*

Table 5.37 displays the percentage of utterances in each context where the greatest variability occurred.

Table 5.37 The percentage of utterances in each context in the voiced plosive utterance group which were assigned a value of one indicating the context where variability was the greatest for most utterances regarding UD

	L1NR (%)	L1FR (%)	L2NR (%)	L2FR (%)	The context with the largest percentage of utterances displaying the greatest SD
AOS1	0	20	80	0	L2NR
AOS2	20	0	0	80	L2FR
AOS3	0	60	20	20	L1FR
N1	40	20	40	0	L1NR and L2NR
N2	20	0	20	60	L2FR
N3	0	20	60	20	L2NR
N4	40	20	0	40	L1NR and L2FR
N5	20	40	0	40	L1FR and L2FR
NGR	20	20	20	40	L2FR
PP1	40	20	0	40	L1NR and L2FR
PP2	20	40	20	20	L1FR
PP3	20	0	60	20	L2NR

AOS1, as well as PP3 exhibited the largest percentage of utterances (80% of utterances for AOS1 and 60% for PP3) with the greatest variability in L2NR, while

AOS2 exhibited 80% of utterances with the greatest variability in L2FR. Subject AOS3 exhibited 60% of utterances with the greatest variability in L1FR and PP2 exhibited 40% in this context, indicating that the L2 contexts did not lead to the greatest variability in these two subjects. The normal group exhibited 40% percent of utterances with the greatest variability in L2FR, while the other three contexts each had 20% of utterances with the greatest variability. PP1 had an equal number of utterances with the greatest variability in L1NR and L2FR respectively, indicating that these two contexts led to the greatest variability for this subject. For utterances beginning with a voiced plosive, there does thus not appear to be a consistent pattern regarding the context which generally led to the greatest variability.

The SDs of the experimental subjects expressed as a percentage of the SDs of the normal group are displayed in Figure 5.23.

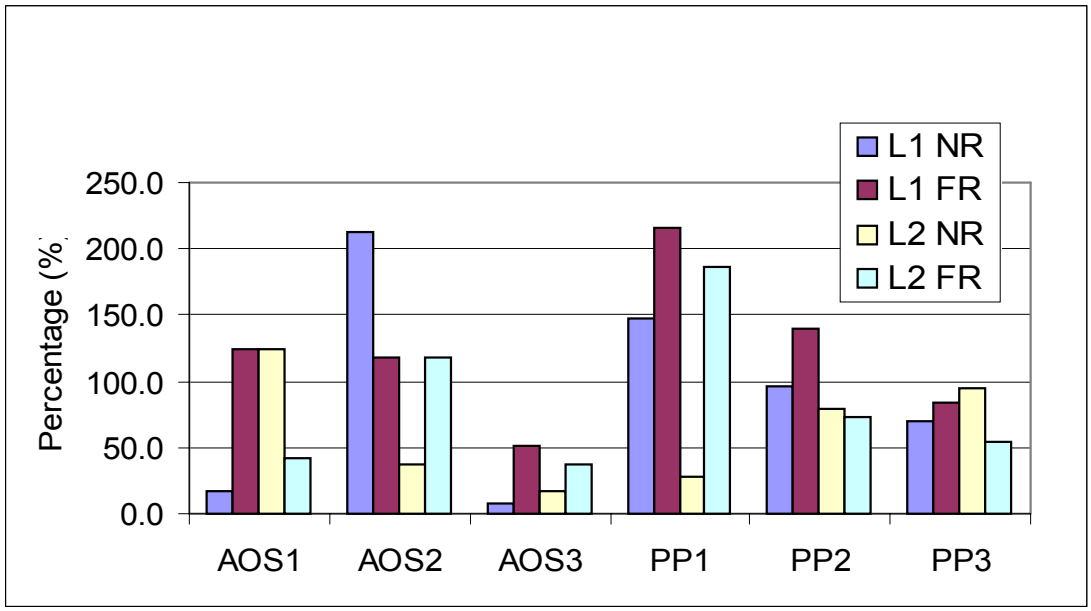

Figure 5.23 The SDs of utterance duration of each subject expressed as a percentage of the SD of the normal group for each context for the voiced plosive utterance group

From Figure 5.23 it is evident that all the experimental subjects exhibited greater SDs than the normal group across all four contexts. From Figure 5.23, it further appears as if the SDs of the subjects with PP are comparable, and in some instances even greater than some of the subjects with AOS. The subjects with AOS had SDs which were between 8.4% (AOS3 in L1NR) and 213.2% (AOS2 in L1NR) greater than those of the normal group, while the subjects with PP had SDs which were between 27.2% (PP1 for L2NR) and 215.3% (PP1 for L1FR) greater than those of the normal group.

5.4.6 Determination of the context (L1NR, L1FR, L2NR and L2FR) in which *variability* of each subject is the greatest for *utterance duration* of utterances beginning with a *voiceless fricative*

A fairly consistent pattern emerged regarding the context where the largest percentage of utterances exhibited the greatest variability, as is evident from Table 5.38.

Table 5.38 The percentage of utterances in each context in the voiceless fricative utterance group which were assigned a value of one indicating the context where variability was the greatest for most utterances regarding UD

	L1NR (%)	L1FR (%)	L2NR (%)	L2FR (%)	The context with the largest percentage of utterances displaying the greatest SD
AOS1	50	25	0	25	L1NR
AOS2	25	75	0	0	L1FR
AOS3	0	25	25	50	L2FR
N1	25	25	50	0	L2NR
N2	0	25	50	25	L2NR
N3	0	25	50	25	L2NR
N4	0	25	50	25	L2NR
N5	0	25	75	0	L2NR
NGR	0	25	75	0	L2NR
PP1	25	25	50	0	L2NR
PP2	25	0	50	25	L2NR
PP3	0	25	25	50	L2FR

Subjects AOS3 and PP3 both exhibited 50% of utterances with the greatest variability in L2FR. PP2 and PP3, as well as all speakers in the normal group and the normal group, exhibited the greatest variability in L2NR. In AOS1 and AOS2, speech production in L2 did not result in greater variability than L1 contexts and these subjects exhibited the largest percentage of utterances with the greatest variability in the L1NR and L1FR context respectively.

The reader is referred to Figure 5.24 for a visual presentation of the SDs of each experimental subjects expressed as a percentage of the SDs of the normal group. From Figure 5.24, it is evident that all the experimental subjects, with the exception of PP3 for L1NR and L2FR, exhibited larger SDs than the normal group. The SDs of the subjects with AOS appear to be greater than those of the subjects with AOS and were between 32.3% (AOS2 for L2NR) and 243.8% (AOS1 for L2FR) larger than those of the normal group. The SDs of the subjects with PP were between 27.9% (PP2 for L1FR) and 153.3% (PP3 for L2FR) larger than those of the normal group.

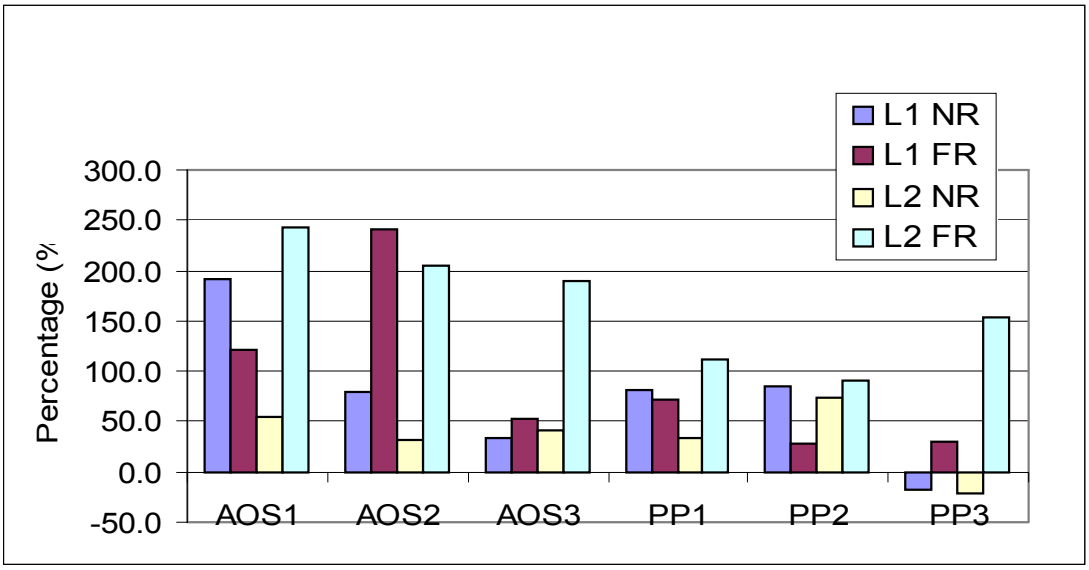

Figure 5.24 The SDs of utterance duration of each subject expressed as a percentage of the SD of the normal group for each context for the voiceless fricative utterance group

5.4.7 Determination of the context (L1NR, L1FR, L2NR and L2FR) in which *variability* of each subject is the greatest for *utterance onset duration* of utterances beginning with a *voiceless plosive*

The reader is referred to Table 5.39 for a summary of the percentage of utterances in each context where the greatest variability occurred. Regarding the context with the largest percentage of utterances exhibiting the greatest SD, it seems that only in subjects AOS1, N2, N3 and PP1, the L2 context led to greater variability. AOS1 exhibited an equal percentage of utterances with the greatest SD in L2NR and L2FR respectively (40% of utterances), indicating that these two contexts led to the same amount of variability regarding UOD in this subject.

Table 5.39 The percentage of utterances in each context in the voiceless plosive utterance group which were assigned a value of one indicating the context where variability was the greatest for most utterances regarding UOD

	L1NR (%)	L1FR (%)	L2NR (%)	L2FR (%)	The context with the largest percentage of utterances displaying the greatest SD
AOS1	0	20	40	40	L2NR and L2FR
AOS2	40	0	40	20	L1NR and L2NR
AOS3	60	20	20	0	L1NR
N1	60	0	40	0	L1NR
N2	0	20	0	80	L2FR
N3	20	0	80	0	L2NR
N4	60	0	40	0	L1NR
N5	0	40	40	20	L1FR and L2NR
NGR	60	0	40	0	L1NR
PP1	40	0	60	0	L2NR
PP2	60	0	0	40	L1NR
PP3	40	20	0	40	L1NR and L2FR

The normal group exhibited the largest percentage of utterances with the greatest SD in the L1NR context. The latter was also true for AOS3, PP2 and some of the normal speakers (N1 and N4). AOS2 had an equal percentage of utterances with the greatest variability in L1NR and L2NR (40% of utterances for each context). PP3 had an equal percentage of utterances with the greatest variability in L1NR and L2FR respectively (40% of utterances each).

From Figure 5.25, displaying the SDs of each experimental subject as a percentage of the SDs of the normal group, it is evident that all subjects exhibited greater SDs than the normal group across all four contexts.

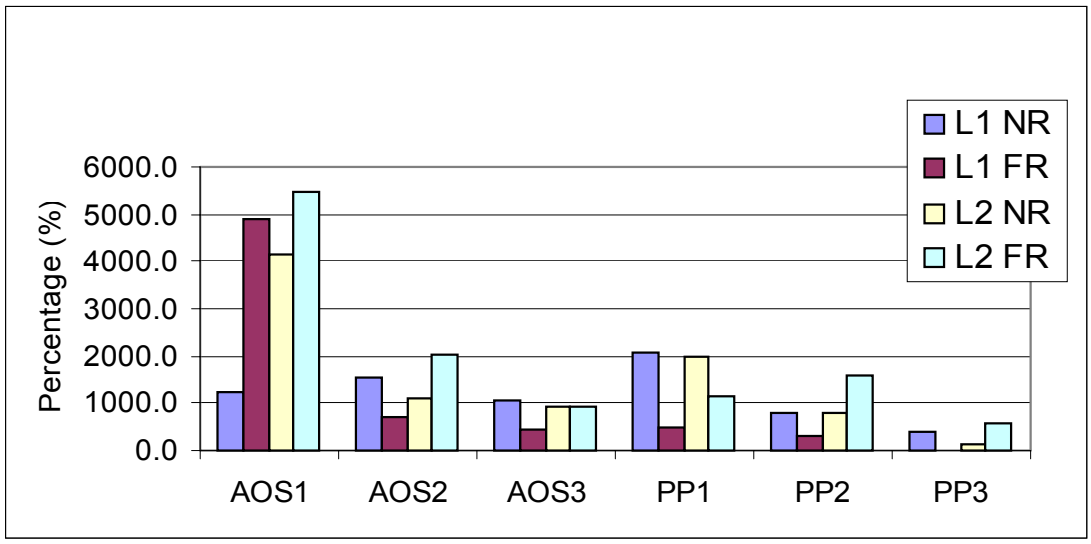

Figure 5.25 The SDs of utterance onset duration of each subject expressed as percentage of the SD of the normal group for each context for the voiceless plosive utterance group

From Figure 5.25, it is further evident that AOS1 had the greatest SDs, while PP3 had the smallest SDs and was thus the least variable regarding UOD. The fact that the SDs of the experimental subjects regarding UOD are much greater than those of the comparison group is because the subjects with AOS and PP often had long periods of time elapsing after production of the carrier phrase to the beginning of production of the target utterance, while other times the target utterance was produced immediately after the carrier phrase. The former behavior led to very large SDs being obtained for the experimental subjects compared to the normal group who consistently initiated the target utterance after the carrier phrase.

5.4.8 Determination of the context (L1NR, L1FR, L2NR and L2FR) in which *variability* of each subject is the greatest for *utterance onset duration* of utterances beginning with a *voiced plosive*

Table 5.40 displays the results regarding the percentage of utterances in each context where the greatest variability occurred.

Table 5.40 The percentage of utterances in each context in the voiced plosive utterance group which were assigned a value of one indicating the context where variability was the greatest for most utterances regarding UOD

	L1NR (%)	L1FR (%)	L2NR (%)	L2FR (%)	The context with the largest percentage of utterances displaying the greatest SD
AOS1	0	20	60	20	L2NR
AOS2	20	40	40	0	L1FR and L2NR
AOS3	0	20	20	60	L2FR
N1	20	0	80	0	L2NR
N2	20	0	0	80	L2FR
N3	40	0	60	0	L2NR
N4	40	40	20	0	L1NR and L1FR
N5	0	20	0	80	L2FR
NGR	20	0	80	0	L2NR
PP1	40	20	20	20	L1NR
PP2	20	40	20	20	L1FR
PP3	20	20	20	40	L2FR

From Table 5.40 it is evident that AOS1, N1, N3 and the normal group exhibited the greatest SD in L2NR indicating that this context led to greater variability in these subjects. Subjects AOS3, N2, N5 and PP3 exhibited the largest percentage of utterances with the greatest variability in L2FR indicating that the increased motor demand together with the L2 context led to the greatest variability in these subjects.

As with the voiceless plosive utterance group, many subjects often displayed the largest or second largest percentage of utterances with the greatest variability in L1NR. This could possibly be due to the fact that the subjects were not exerting conscious processing strategies during production in L1, which is presumably an automated context of speech production, or they might not have been performing at their best yet due to the fact that L1 utterances were recorded first.

From Figure 5.26, which displays the SDs of each experimental subject expressed as a percentage of the SDs of the normal group, it is evident that all subjects exhibited SDs greater than those of the normal group across all contexts. As with the voiceless plosive group, AOS1 had the greatest SDs in all contexts with PP2 and PP3 generally exhibiting the smallest SDs compared to the normal group.

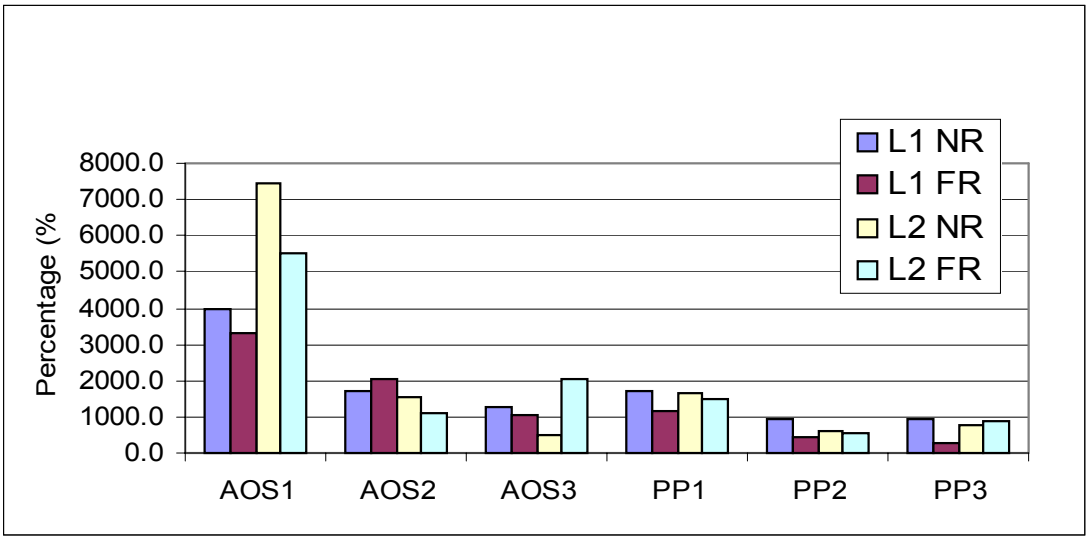

Figure 5.26 The SDs of utterance onset duration of each subject expressed as a percentage of the SD of the normal group for each context for the voiced plosive utterance group

5.4.9 Determination of the context (L1NR, L1FR, L2NR and L2FR) in which *variability* of each subject is the greatest for *voice onset time* of utterances beginning with a *voiceless plosive*

Table 5.41 indicates the percentage of utterances in each context that exhibited the greatest variability.

Table 5.41 The percentage of utterances in each context in the voiceless plosive utterance group which were assigned a value of one indicating the context where variability was the greatest for most utterances regarding VOT

	L1NR (%)	L1FR (%)	L2NR (%)	L2FR (%)	The context with the largest percentage of utterances displaying the greatest SD
AOS1	40	0	40	20	L1NR and L2NR
AOS2	80	0	20	0	L1NR
AOS3	0	0	60	40	L2NR
N1	40	0	60	0	L2NR
N2	20	0	60	20	L2NR
N3	40	0	40	20	L1NR and L2NR
N4	60	20	20	0	L1NR
N5	0	80	60	0	L1FR
NGR	60	0	40	0	L1NR
PP1	40	0	60	0	L2NR
PP2	60	0	40	0	L1NR
PP3	0	0	60	40	L2NR

Three subjects, AOS3, PP1, PP3 and two normal speakers, N1 and N2, exhibited the largest percentage of utterances with the greatest variability in L2NR indicating that the L2 context presumably led to greater variability in these subjects. However, the L2FR context did not seem to lead to greater variability in these subjects. When rate had to be increased in L2FR, more conscious processing was possibly applied causing greater precision of repeated production of an utterance. All other experimental subjects and normal speakers exhibited the largest percentage of utterances with the greatest variability in L1NR with the exception of N5 where L1FR was the context with the largest percentage of utterances with the greatest variability. AOS1 and N3 had an equal percentage of utterances with the greatest variability in L1NR and L2NR. It is evident that all subjects were not affected similarly by the language and/or rate contexts regarding increased variability.

From Figure 5.27, displaying the SDs of each experimental subject as a percentage of the SDs of the normal group, it is evident that all the experimental subjects, with the exception of PP3 for L1NR, exhibited greater SDs than the normal group across all four contexts. AOS2 exhibited the smallest SDs which were between 12.7% and 71.4% greater than those of the normal group, while AOS2 exhibited the largest SDs which were between 15% and 274% greater than those of the normal group.

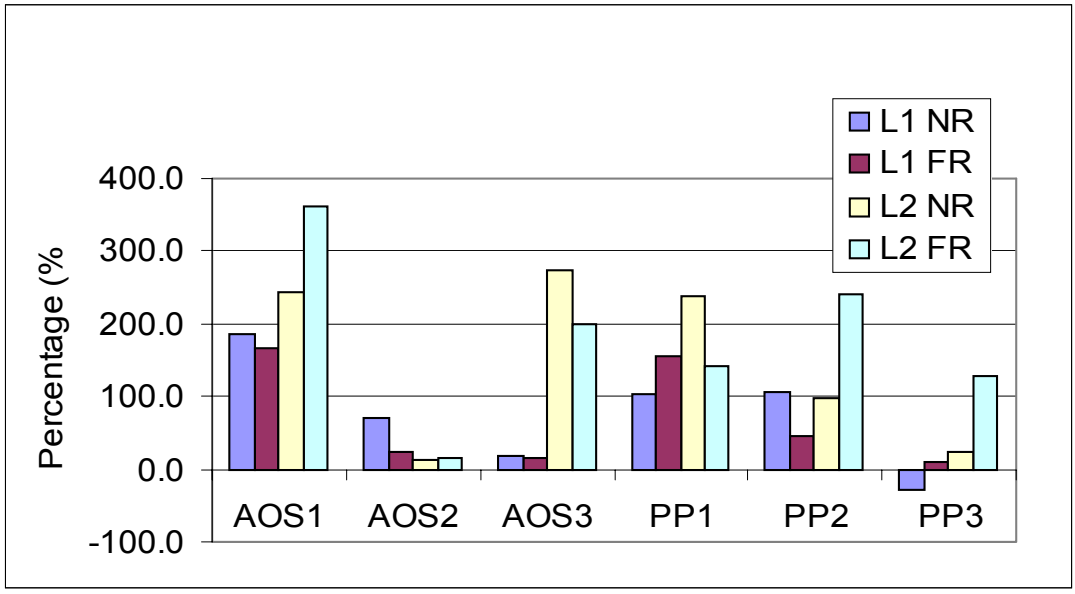

Figure 5.27 The SDs of voice onset time of each subject expressed as a percentage of the SD of the normal group for each context for the voiceless plosive utterance group

5.4.10 Determination of the context (L1NR, L1FR, L2NR and L2FR) in which *variability* of each subject is the greatest for *voice onset time* of utterances beginning with a *voiced plosive*

The results regarding the percentage of utterances in each context where the variability was the greatest for the voiced plosive group are displayed in Table 5.42.

Table 5.42 The percentage of utterances in each context in the voiced plosive utterance group which were assigned a value of one indicating the context where variability was the greatest for most utterances regarding VOT

	L1NR (%)	L1FR (%)	L2NR (%)	L2FR (%)	The context with the largest percentage of utterances displaying the greatest SD
AOS1	0	20	40	40	L2NR and L2FR
AOS2	40	0	40	20	L1NR and L2NR
AOS3	40	40	20	0	L1NR and L1FR
N1	40	40	0	20	L1NR and L1FR
N2	60	0	20	20	L1NR
N3	60	0	40	0	L1NR
N4	80	0	20	0	L1NR
N5	0	40	0	60	L2FR
NGR	60	0	20	20	L1NR
PP1	40	40	0	20	L1NR and L1FR
PP2	0	40	60	0	L2NR
PP3	40	40	0	20	L1NR and L1FR

As with the voiceless plosive group, there does not appear to be a trend of the largest percentage of utterances with the greatest variability regarding VOT occurring in the L2NR or L2FR context. Three of the five normal speakers had the greatest variability in L1NR. N1 had an equal percentage of utterances with the largest SD in L1NR and L1FR, whereas N5 had the largest percentage of utterances with the greatest variability in L2FR. As a group, the normal speakers exhibited the largest percentage of utterances with the greatest variability in L1NR.

The L2 context appears to have led to greater variability in AOS1, since this speaker had an equal percentage of utterances with the greatest SD in L2NR and L2FR. AOS2 exhibited an equal percentage of utterances with the greatest variability in L1NR and L2NR, while AOS3 exhibited an equal percentage of utterances with the greatest variability in L1NR and L1FR. PP1 and PP3 both had an equal percentage of utterances with the greatest variability in L1NR and L1FR. Subject PP2 had the greatest variability in L2NR, indicating that the L2 context might have influenced variability in this subject, although repetitive productions of the same utterance became more accurate in the L2FR context.

From Figure 5.28, displaying the SDs of each experimental subject as a percentage of the SDs of the normal group, it is evident that none of the experimental subjects, with the exception of PP1, had greater SDs than the normal group across all four contexts. This is an interesting finding, since most of the experimental subjects generally exhibited greater SDs across all four contexts regarding the other temporal parameters which were measured.

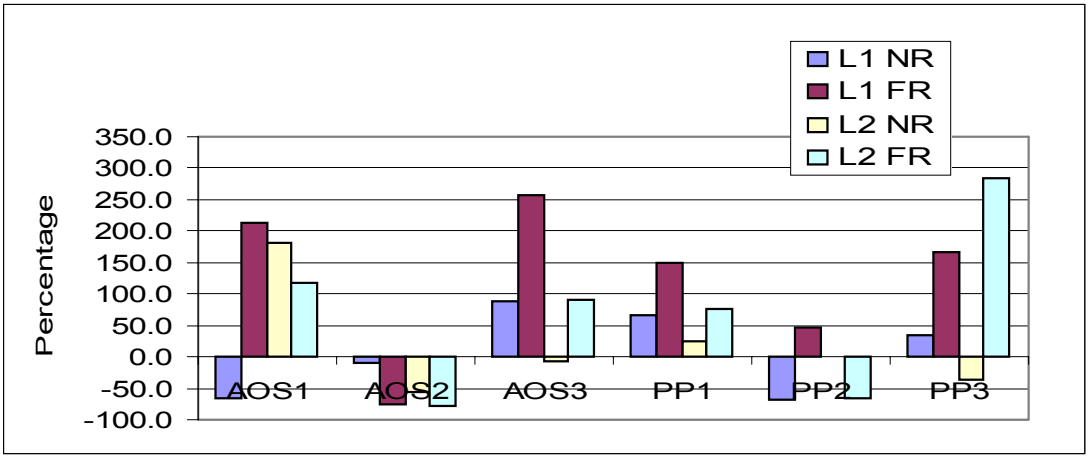

Figure 5.28 The SDs of voice onset time of each subject expressed as a percentage of the SD of the normal group for each context for the voiced plosive utterance group

5.4.11 Summary of results for sub-aim three

Table 5.43 presents a summary of the findings pertaining to sub-aim three. In Table 5.43, it is it indicated if the main predictions for sub-aim three were realized. It was predicted that the context which posed the greatest demands to the speech production mechanism would result in the greatest variability in subjects who have a compromised speech production mechanism. An increase in speaking rate was hypothesized to increase the demands to the speech mechanism and increased rate, in addition to speech production in L2, was predicted to be the context which would pose the greatest demands to the speech mechanisms of the experimental subjects. It was not certain how normal speakers would react to these increased demands, but since the test stimuli used were phonemically and phonetically similar and the normal speech motor mechanism is flexible in making adjustments to the context, it was predicted that normal speakers would be able to sufficiently adapt to the increased processing demands. The L2FR context would thus not necessarily have increased variability in speakers with normal speech and language abilities.

In Table 5.43 it is indicated with an X for each parameter and utterance group if a subject exhibited the largest percentage of utterances with the greatest SD either in L2NR (finding A, indicated in blue) or in L2FR (finding B, indicated in red). It is also indicated with an X (finding C, indicated in green) if a subject exhibited greater SDs than the normal group for a specific utterance group across all four contexts. When two contexts had an equal percentage of utterances exhibiting the greatest SD, the context equal to either L2NR or L2FR is cited under either finding A (equal to L2NR) or finding B (equal to L2FR), depending on the context to which it was equal.

For the experimental subjects individual patterns emerged regarding the context in which the most utterances had the greatest variability. In the normal speakers, however, it appears as if the L2NR and L2FR context generally rendered the largest percentage of utterances with the greatest SD, with the exception of VOT. This trend of the largest percentage of utterances with the greatest SDs occurring in either L2NR or L2FR was not as readily observed in the experimental subjects. The fact that the normal group generally exhibited the most utterances with the greatest variability in either L2NR of L2FR could be indicative of the fact that the L2 context generally led to greater variability and consequently made speech production less precise during repetitive production of a specific utterance for the normal speakers.

Table 5.43 Summarized findings related to sub-aim three indicating whether the context with the largest percentage of utterances exhibiting the greatest variability was either L2NR or L2FR and if the SDs of each experimental subject were greater than those of the normal group across all four contexts

	Utterance Group	Finding	AOS1	AOS2	AOS3	PP1	PP2	PP3	N1	N2	N3	N4	N5	NGR
Vowel duration	Voiceless Plosives													
		A	X			X	X		X	L1NR		X		X
		B	X	L1FR			X		X		L1FR			X
		C		X	X									
	Voiced Plosives													
		A							X	X				
		B	X				X				X	L1NR	X	X
		C	X	X	X	X	X	X						
	Voiceless Fricative													
		A	X	X			X		X	X				X
		B									X	X		
		C	X	X	X		X							
Utterance duration	Voiceless Plosives													
		A							X			X	X	X
		B	L1NR	X	X					X		X		
		C	X	X		X	X	X						
	Voiced Plosives													
		A	X					X	L1NR		X			
		B		X		L1NR				X		L1NR	L1FR	X
		C	X	X	X	X	X	X						
	Voiceless Fricative													
		A				X	X		X	X	X	X	X	X
		B			X			X						
		C	X	X	X	X	X							
Utterance onset duration	Voiceless Plosives													
		A	X	L1NR		X					X		L1FR	
		B	X					L1NR		X				
		C	X	X	X	X	X	X						
	Voiced Plosives													
		A	X	L1FR					X		X			X
		B			X			X		X			X	
		C	X	X	X	X	X	X						
Voice onset time	Voiceless Plosives													
		A	L1NR		X	X		X	X	X	L1NR			
		B												
		C	X	X	X	X	X							
	Voiced Plosives													
		A	X	L1NR			X							
		B	X										X	
		C				X								

A=The context which rendered the largest percentage of utterances with the greatest SD is L2NR
B=The context which rendered the largest percentage of utterances with the greatest SD is L2FR
C=The SD of the experimental subject was greater than that of the normal group across all four contexts

The specific L2 context (either L1NR or L1FR) in which the greatest variability occurred in the *normal speakers*, appeared to differ between subjects. Sometimes L2NR led to the greatest variability whereas other times L2FR led to the greatest variability. For the normal speakers as a group, more instances occurred in L2NR than L2FR where the largest percentage of utterances exhibited the greatest SDs. Apart from N1 who generally displayed the most utterances with the greatest variability in L2NR, the other normal subjects' results regarding the context with the greatest variability fluctuated between L2NR and L2FR. It was only for the voiceless fricative utterance group regarding UD that all normal speakers obtained the largest percentage of utterances with the greatest variability in L2NR. When speaking at a faster than normal rate, accuracy of repeated production thus appears to increase in normal speakers despite production in L2.

In some instances a L1 context had an equal percentage of utterances with the greatest variability as either L2NR or L2FR. The context which exhibited the same percentage of utterances with the greatest variability as either L2NR or L2FR was most often L1NR in the normal speakers. The finding of an L1 context exhibiting an equal percentage of utterances with the greatest SD as a L2 context, only occurred twice at most for a single normal speaker across all measured parameters and utterance groups.

Regarding the findings pertaining to sub-aim three for the *experimental subjects*, individual patterns emerged regarding the context where the greatest variability was generally observed. From Table 5.43 it is evident that subject AOS1 generally exhibited the most utterances with the greatest SDs in either L2NR or L2FR. AOS2, on the other hand, although exhibiting instances where the largest percentage of utterances had the greatest variability in either L2NR or L2FR, often had L1NR and L1FR sharing this position with either L2NR or L2FR. For this subject a consistent pattern regarding the context with the greatest variability did thus not emerge. For subject AOS3 the greatest variability was observed in L2FR for the voiceless plosive and voiceless fricative utterance groups regarding UOD and for the voiced plosive utterance group regarding UOD. AOS3 furthermore exhibited the largest percentage of utterances with the greatest SD in L2NR for the voiceless plosive utterance group regarding VOT. For VD the largest percentage of utterances with the greatest SD never occurred in either L2NR or L2FR for AOS3. The results of subject AOS3 thus

imply that temporal control of certain parameters might be more subject to the influence of L2.

With the exception of VOT for the voiced plosive utterance group, all the subjects with AOS generally exhibited greater SDs than the normal group across all four contexts. Thus even though a consistent pattern did not emerge regarding the greatest variability occurring in either L2NR or L2FR, with the exception of AOS1, all subjects with AOS appear to be more variable than the normal group across all four contexts. The fact that the subjects with AOS are already much more variable than normal, might have made it more difficult for the effect of L2 to be visible in their results.

When viewing the data of the subjects with PP, it is evident that these subjects also exhibit fewer instances of the largest percentage of utterances with the greatest SDs occurring in either L2NR or L2FR compared to the normal group. Of the three subjects with PP, subject PP3 most frequently exhibited the largest percentage of utterances with the greatest SDs in either L2NR or L2FR. In the subjects with PP, the L2NR or L2FR context does not appear to have led to more utterances exhibiting the greatest variability. It is further evident that all the subjects with PP generally exhibited greater SDs than the normal group across all four contexts. There were a few instances in the subjects with PP (two instances in PP1, two in PP2 and five in PP3) where they did not exhibit greater SDs than the normal group across all four contexts. From examination of Figures 5.19 to 5.28, it is evident that the subjects with AOS generally had greater SDs than the subjects with PP regarding VD and UOD.

In summary, the results for sub-aim three, for the experimental subjects, with the exception of AOS1 do not appear to render a consistent pattern regarding the largest percentage of utterances with the greatest variability occurring in either L2NR or L2FR. For the normal group it does appear, however, that L2NR and L2FR generally led to the largest percentage of utterances with the greatest variability. Furthermore, the subjects with AOS and PP, with a few exceptions, generally exhibited greater SDs than the normal group across all four contexts. The subjects with AOS appeared to have greater SDs than the subjects with PP regarding VD and UOD. Although all subjects with PP had greater SDs than the normal group regarding VOT of the

voiceless plosive utterance group, only PP1 exhibited this behavior regarding VOT of the voiced plosive utterance group.

5.5 SUMMARY OF CHAPTER FIVE

In this chapter, the results of the study were presented according to the formulated sub-aims. These results entailed description of specific temporal parameters of speech production across four contexts in normal speakers, persons with AOS and persons with PP. Chapter five serves as an introduction to chapter six where the results are interpreted and discussed with reference to relevant research and theoretical issues.