

CHAPTER 4

FINDINGS AND DISCUSSION

4.0 Introduction

In this chapter, the findings for this research are discussed with reference to the objectives put forth in Chapter 1. The presentation of the findings is divided into two main sections. The first section presents the findings of Experiment 1; the second section presents the findings of Experiment 2. The findings are further divided into duration and fundamental frequency, the two correlates of stress measured in this study. The measurements taken were analysed to see how the Malaysian English (ME) subjects place lexical stress in polysyllabic words, specifically adverbs (Experiment 1) and nouns (Experiment 2). The results were then compared with Low and Grabe's (1999) findings in their study of lexical stress placement in Singapore English (SgE) and British English (BrE) to find similarities or differences between the three varieties of English.

4.1 Findings from Experiment 1

In the first experiment, the duration of the final syllable of the three syllables was compared with that of the immediately preceding syllable in two contexts: when the word is in a phrase-final position and when it is in a phrase-medial position. The fundamental frequency (F0) of the voiced portions of each syllable was also examined (see 3.4.2). The results are presented in the following sections.

4.1.1 Duration

The table below shows the difference in average duration in milliseconds (ms) between the penultimate and final syllable of the ten test words in both phrase-final and phrase-medial positions. The difference is calculated by subtracting the duration of the penultimate syllable from the duration of the final syllable. A positive value shows that the duration of the final syllable is longer than that of the penultimate syllable, while a negative value denotes a shorter final syllable compared to the penultimate syllable.

Table 4.1: Average duration of the difference between penultimate and final syllables in phrase-final and phrase-medial positions in Experiment 1

Phrase-final position		Phrase-medial position	
Word	Difference (ms)	Word	Difference (ms)
1	-27	1	8
2	-10	2	-137
3	-5	3	-85
4	51	4	-34
5	66	5	-43
6	96	6	-6
7	48	7	-60
8	-35	8	-69
9	-61	9	-22
10	-22	10	-69
Average	10	Average	-52

As can be seen from the table, the average duration in the phrase-final position is 10ms, where the final syllable is 10ms longer than the penultimate syllable. In the phrase-medial position, the average duration is 52ms, where the final syllable is 52ms shorter than the penultimate syllable. A t-test shows that the mean difference between the average duration between the two positions was significant, $t(9) 3.3$, $p < 0.01$. If the ME speakers

placed lexical stress on the final syllable of the test words, there would be durational correlation in both the data. Instead, in the absence of phrase-final lengthening, there is a decrease in duration between the penultimate and the final syllable in some of the words. This is a similar finding to Low and Grabe's (1999, p. 46) comparison of average syllable durations between SgE and BrE, where they found more phrase-final lengthening in SgE compared to BrE while cross-varietal difference disappears in phrase-medial position. In other words, the results in Table 4.1 suggest that ME speakers do not stress the final syllable of words. Rather, it is the phrase-final lengthening in ME speakers that may have led to the assumption that lexical stress is placed on the final syllable of polysyllabic words.

However, when each word is examined individually, in six of the words (1, 2, 3, 8, 9 and 10) in the phrase-final position, the average duration of the final syllable is shorter than the penultimate syllable, as indicated by the negative values. In other words, there are less instances of the final syllable being longer than the penultimate one. In the phrase-medial position, it can be clearly seen that in nine out of ten test words, the average duration of the final syllable is shorter than the penultimate syllable, as expected in this context. The average duration for each syllable in both positions is shown in Table 4.2 and illustrated in Figures 4.1 to 4.10.

Table 4.2: Average duration for each syllable in the phrase-final and phrase-medial positions in Experiment 1

Phrase-final position				Phrase-medial position			
Word	Sy1	Sy2	Sy3	Word	Sy1	Sy2	Sy3
1	230	183	156	1	227	150	158
2	185	274	263	2	220	263	127
3	236	263	258	3	210	241	156
4	214	229	280	4	182	205	171
5	270	222	287	5	238	193	150
6	306	195	291	6	284	173	167
7	192	227	274	7	184	206	146
8	193	242	207	8	200	227	157
9	353	337	276	9	295	236	214
10	315	283	261	10	316	247	179
Average	249	245	255	Average	236	214	162

The average duration for each syllable in the first word, *manfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.1.

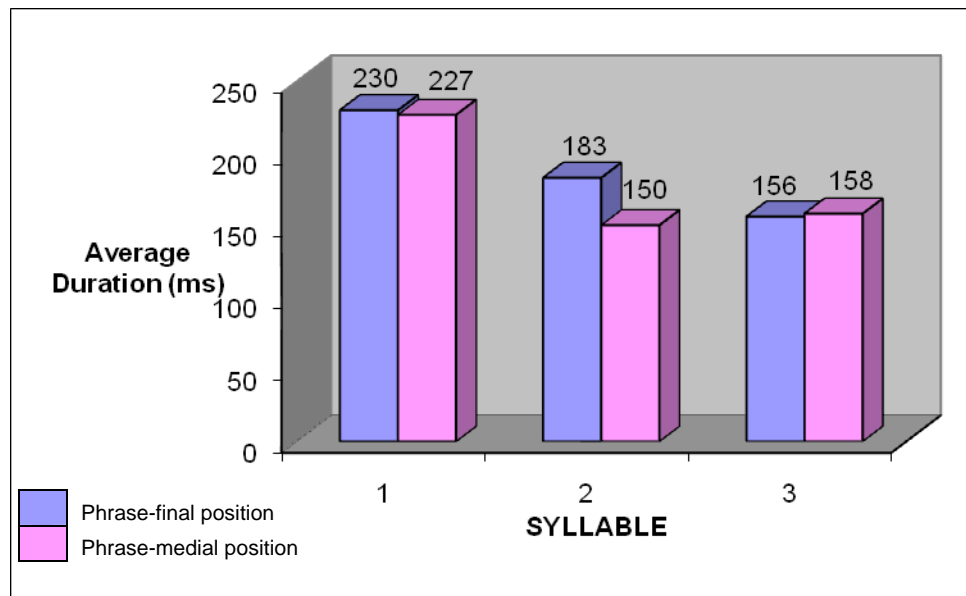


Figure 4.1: Average duration for each syllable in *manfully* in phrase-final and phrase-medial positions

Figure 4.1 shows that the initial syllable of the word *manfully* has the longest average duration in both phrase-final and phrase-medial positions, 230ms and 227ms respectively. The final syllable is the shortest in the phrase-final position (156ms), while the average duration of the final syllable in the phrase-medial position is 158ms. The shortest syllable for *manfully* in the phrase-medial position is the penultimate syllable (150ms) and not the final syllable due to long final syllable durations of 268ms and 216ms by two speakers, Speaker 1 and Speaker 5. If the measurements of these two speakers are removed, the average durations of the initial, penultimate and final syllables are 185ms, 116ms and 110ms respectively, where the final syllable is the shortest. The durations in Figure 4.1 suggest that lexical stress is placed on the initial syllable for the word *manfully* both in phrase-final and phrase-medial positions, as the average duration of the initial syllable is the longest in both positions, thus negating the assumption that speakers tend to stress the final syllable in polysyllabic words.

The average duration for each syllable in the second word, *hopelessly*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.2 below.

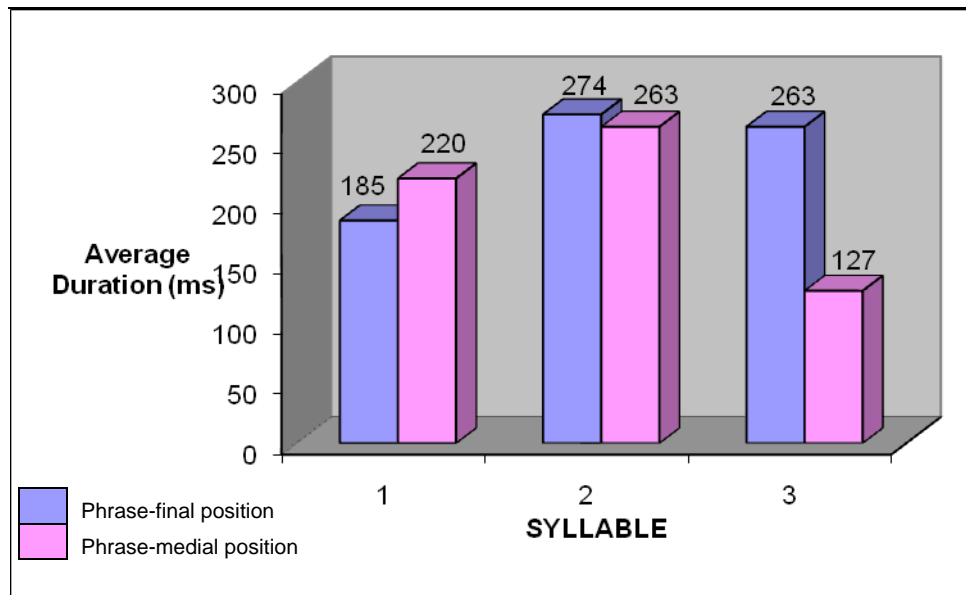


Figure 4.2: Average duration for each syllable in *hopelessly* in phrase-final and phrase-medial positions

Figure 4.2 shows a similar pattern between the average duration in phrase-final position and the average duration in phrase-medial position in the word *hopelessly*. The initial syllable is relatively shorter than the penultimate syllable, while the final syllable is comparatively shorter than the penultimate syllable in both positions. The longest average duration for a syllable is in the penultimate syllable in both phrase-final and phrase-medial positions. Compared to the phrase-medial position, the difference between the average duration of the final syllable and the penultimate syllable is very small (11ms). The shortest syllable in phrase-final position is the initial syllable (185ms) and not the final syllable (263ms) due to three long final syllable durations of 569ms (Speaker 5), 301ms (Speaker 7) and 340ms (Speaker 8). If the measurements of these three speakers are removed, the average durations of the initial, penultimate and final syllables are

113ms, 180ms and 142ms respectively, where the final syllable is much shorter than the penultimate syllable but still longer than the initial syllable. The shortest syllable in phrase-medial position is the final syllable (127ms). The durations in Figure 4.2 suggest that lexical stress may have been placed on the penultimate syllable both in phrase-final and phrase-medial positions, as the average duration of the penultimate syllable is the longest in both positions.

The average duration for each syllable in the third word, *endlessly*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.3 below.

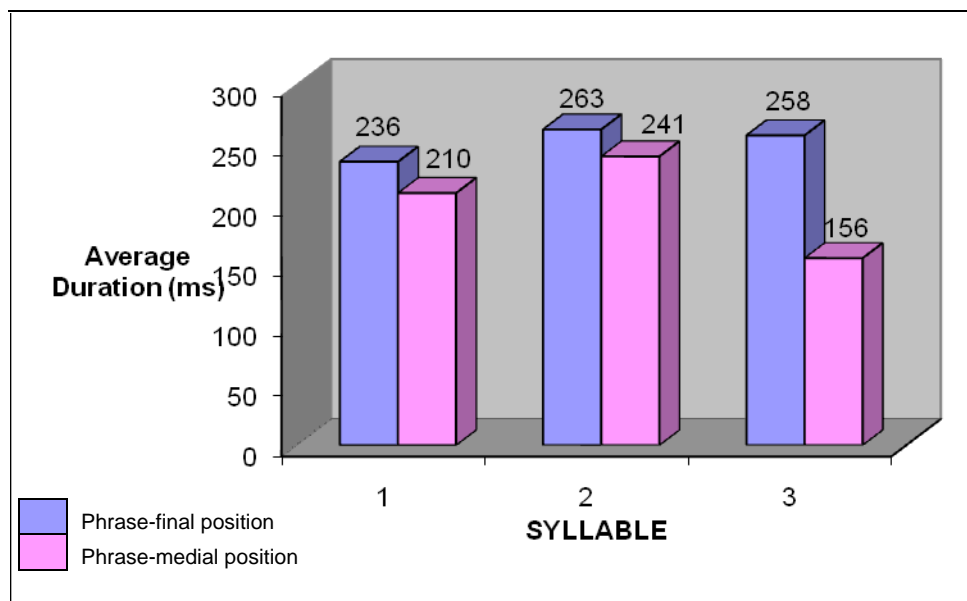


Figure 4.3: Average duration for each syllable in *endlessly* in phrase-final and phrase-medial positions

Similar to *hopelessly*, Figure 4.3 shows a similar pattern between the average duration in phrase-final position and the average duration in phrase-medial position in the word *endlessly*. The initial syllable is relatively shorter than the penultimate syllable, while the final syllable is comparatively shorter than the penultimate syllable in both positions. The

longest average duration for a syllable is in the penultimate syllable in both phrase-final and phrase-medial positions, 263ms and 241ms respectively. The final syllable is the shortest in phrase-medial position (156ms) while the initial syllable is the shortest in phrase-final position (236ms), compared to the penultimate and final syllables (263ms and 258ms respectively). The average duration of the final syllable in the phrase-final position could have been shorter as Speaker 5 recorded 424ms for that syllable. If Speaker 5's measurement is removed, the average durations of the initial, penultimate and final syllables are 214ms, 239ms and 216ms respectively, where the final syllable is much shorter than the penultimate syllable. The durations in Figure 4.3 suggest that lexical stress may have been placed on the penultimate syllable both in phrase-final and phrase-medial positions.

The average duration for each syllable in the fourth word, *playfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.4 below.

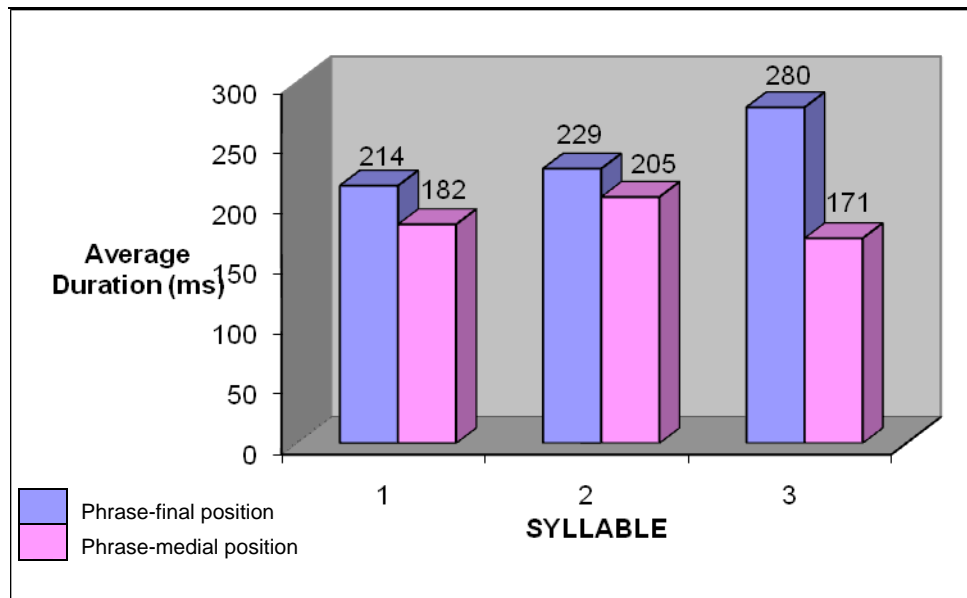


Figure 4.4: Average duration for each syllable in *playfully* in phrase-final and phrase-medial positions

Figure 4.4 shows a similar pattern between the average duration of the syllables in the word *playfully* in phrase-final position and the average duration in phrase-medial position in the first two syllables. The initial syllable is relatively shorter than the penultimate with the initial syllable in the phrase-final position measuring 214ms compared to 229ms and the initial syllable in the phrase-medial position measuring 182ms compared to 205ms in the penultimate syllable. The difference is in the final syllable, where in phrase-medial position, the final syllable is the shortest (171ms) while there is phrase-final lengthening in the phrase-final position (280ms). In the absence of phrase-final lengthening in phrase-medial position, the average duration of the final syllable is the shortest.

The average duration for each syllable in the fifth word, *cheerfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.5 below.

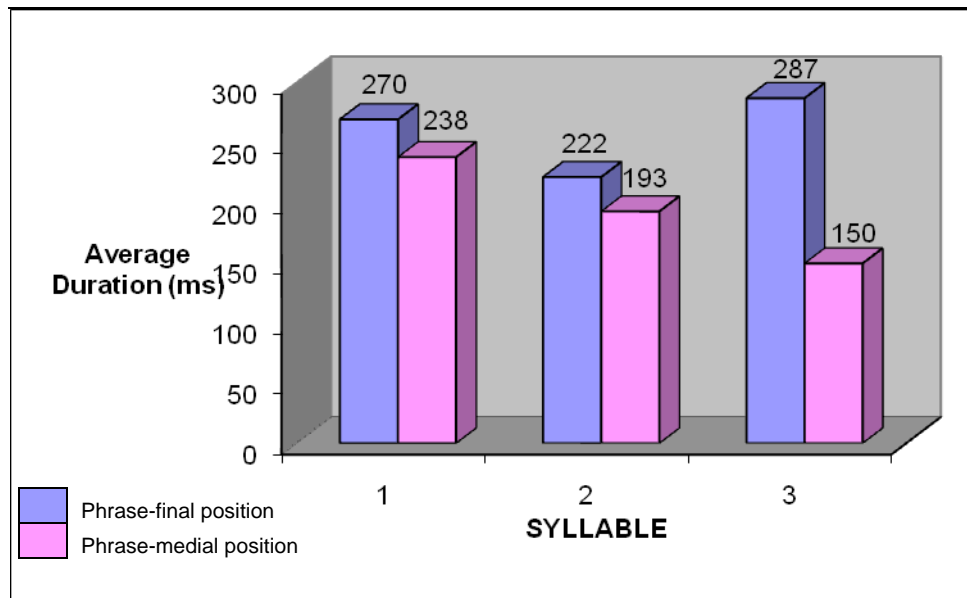


Figure 4.5: Average duration for each syllable in *cheerfully* in phrase-final and phrase-medial positions

Figure 4.5 shows a similar pattern between the average duration of the syllables in the word *cheerfully* in phrase-final position and the average duration in phrase-medial position in the first two syllables, that is, the initial syllable is relatively longer than the penultimate. The average duration of the initial syllable in phrase-final position is 270ms, which is longer than the penultimate syllable (222ms). The same pattern is observed in the phrase-medial position where the average duration of the initial syllable is 238ms compared to a shorter penultimate syllable (193ms). In phrase-medial position, the final syllable is the shortest (150ms) while there is phrase-final lengthening in the phrase-final position (287ms). In the absence of phrase-final lengthening in phrase-medial position, the average duration of the final syllable is the shortest.

The average duration for each syllable in the sixth word, *sinfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.6 below.

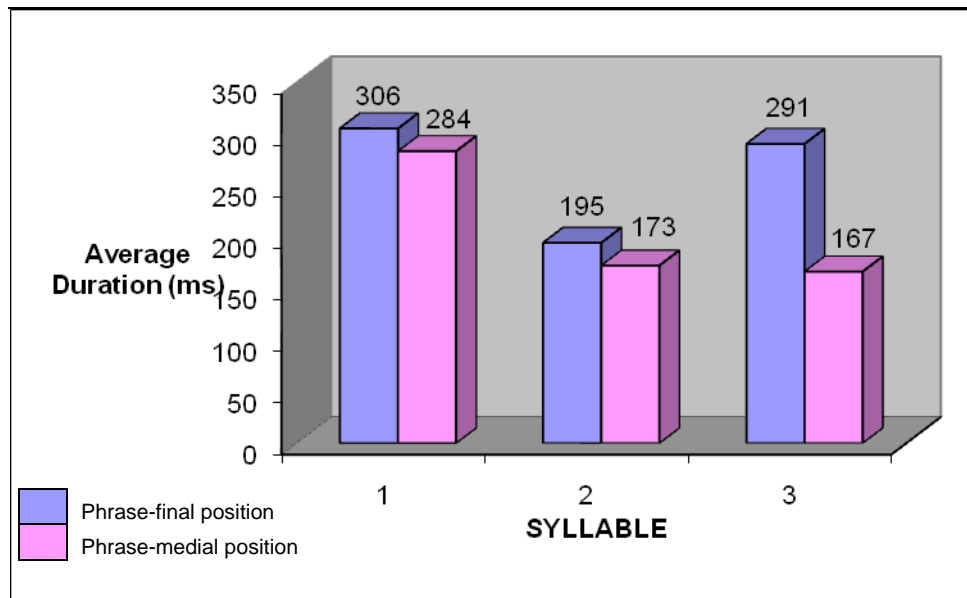


Figure 4.6: Average duration for each syllable in *sinfully* in phrase-final and phrase-medial positions

Figure 4.6 shows a similar pattern between the average duration of the syllables in the word *sinfully* in phrase-final position and the average duration in phrase-medial position in the first two syllables. The initial syllable is longer than the penultimate syllable (306ms) in the phrase-final position compared to 195ms in the penultimate syllable in the same position. In phrase-medial position, the average duration of the initial syllable is 284ms compared to 173ms in the penultimate syllable. The initial syllable is the longest syllable in both positions. In phrase-medial position, the final syllable is the shortest (167ms) while there is phrase-final lengthening in the phrase-final position (291ms). In the absence of phrase-final lengthening in phrase-medial position, the average duration of the final syllable is the shortest.

The average duration for each syllable in the seventh word, *carefully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.7.

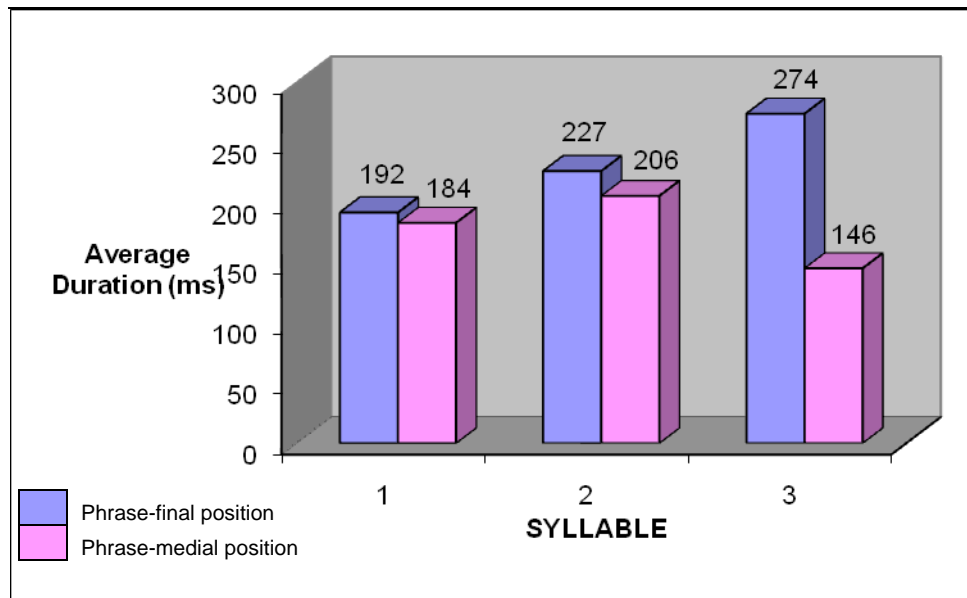


Figure 4.7: Average duration for each syllable in *carefully* in phrase-final and phrase-medial positions

Figure 4.7 shows a similar pattern in the average duration in the first two syllables of the word *carefully* in phrase-final and phrase-medial positions. The initial syllable is comparatively shorter than the penultimate syllable (192ms) in the initial syllable in the phrase-final position compared to 227ms in the penultimate syllable, and 184ms in the initial syllable in the phrase-medial position compared to 206ms in the penultimate syllable. In phrase-medial position, the final syllable is the shortest (146ms) while there is phrase-final lengthening in the phrase-final position (274ms). In the absence of phrase-final lengthening in phrase-medial position, the average duration of the final syllable is the shortest.

The average duration for each syllable in the eighth word, *wilfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.8.

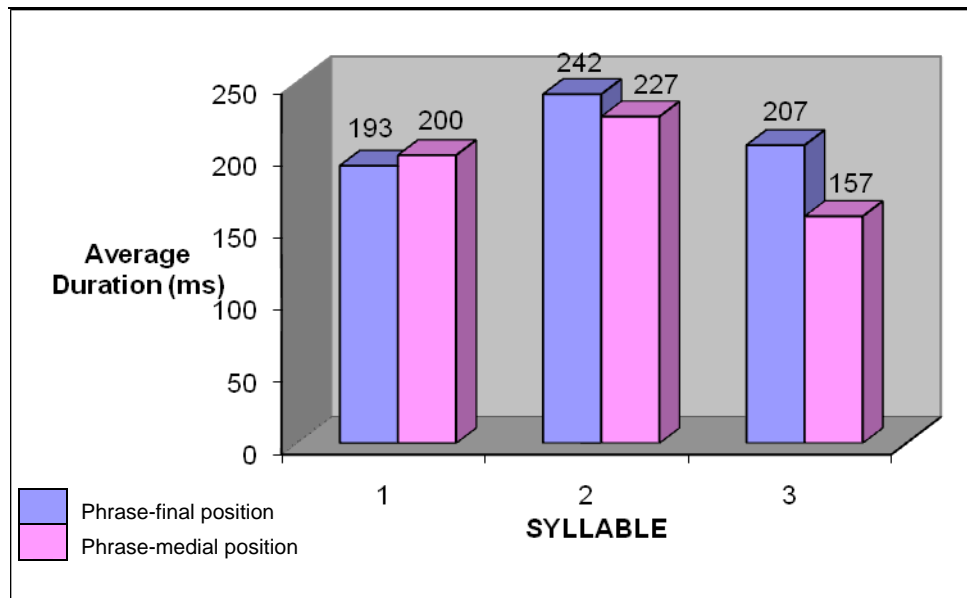


Figure 4.8: Average duration for each syllable in *wilfully* in phrase-final and phrase-medial positions

Figure 4.8 shows a similar pattern between the average duration of the syllables in the word *wilfully* in phrase-final position and the average duration in phrase-medial position. The penultimate syllable is the longest in both phrase-final (242ms) and phrase-medial (227ms) positions. The initial syllable is relatively shorter than the penultimate and the final syllable is shorter than the penultimate syllable. In phrase-medial position the final syllable is the shortest (157ms) while the initial syllable is the shortest in phrase-final position (193ms). In phrase-final position, there is no phrase-final lengthening as the final syllable is shorter than the penultimate syllable, 207ms in the final syllable compared to 242ms in the penultimate syllable.

The average duration for each syllable in the ninth word, *slothfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.9 below.

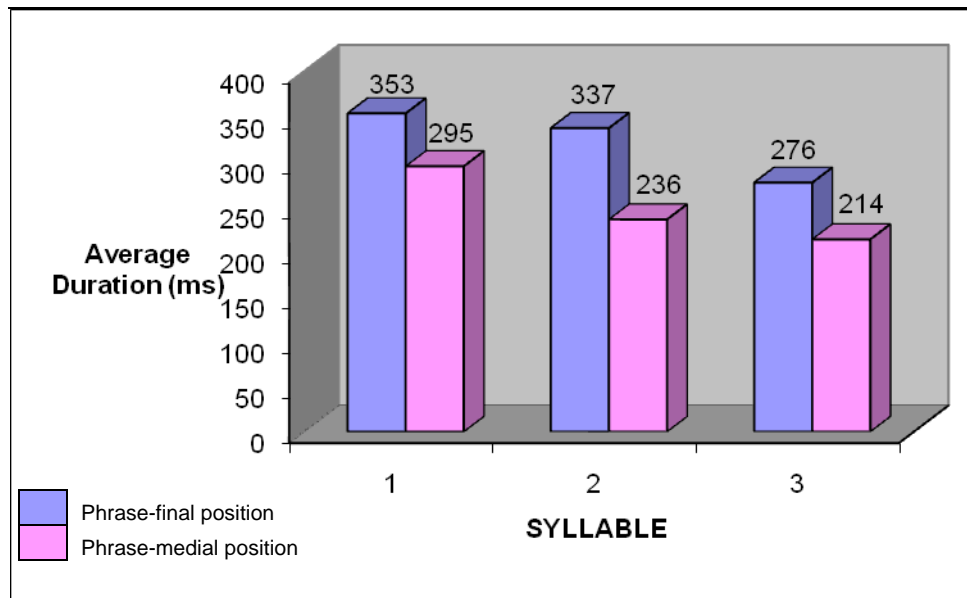


Figure 4.9: Average duration for each syllable in *slothfully* in phrase-final and phrase-medial positions

Figure 4.9 shows that the initial syllable of the word *slothfully* has the longest average duration in both phrase-final and phrase-medial positions (353ms and 295ms respectively), followed by the penultimate syllable, 337ms in phrase-final position and 236ms in phrase-medial position. The final syllable is the shortest in both positions, 276ms in the phrase-final position and 214ms in the phrase-medial position. The durations in Figure 4.9 suggest that there is no phrase-final lengthening and lexical stress may have been placed on the initial syllable for the word *slothfully* both in phrase-final and phrase-medial positions, as the average duration of the initial syllable is the longest in both positions.

The average duration for each syllable in the tenth and last word, *flawlessly*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.10.

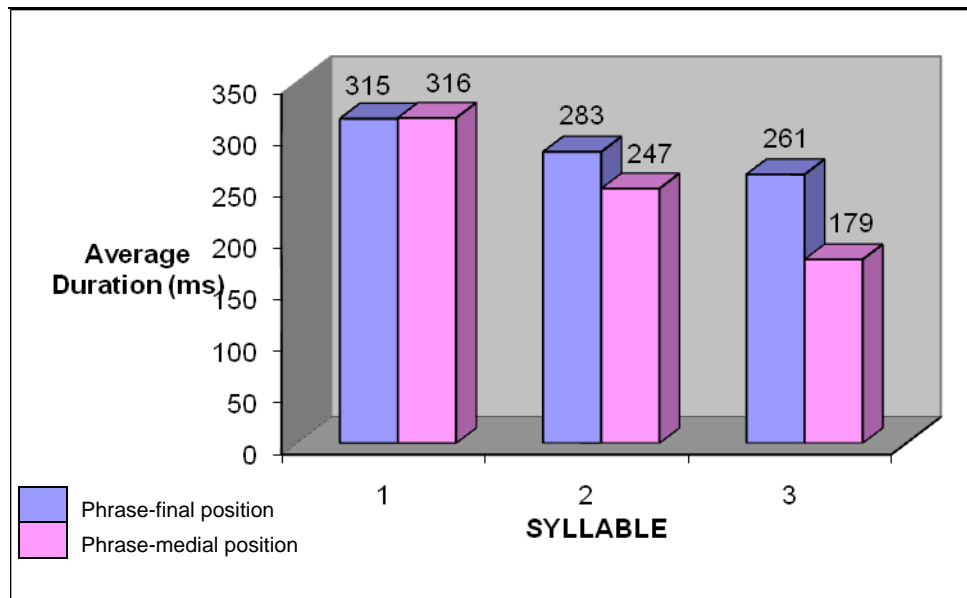


Figure 4.10: Average duration for each syllable in *flawlessly* in phrase-final and phrase-medial positions

Figure 4.10 shows a similar pattern in the average duration of the word *flawlessly*. The initial syllable has the longest average duration in both phrase-final and phrase-medial positions (315ms and 316ms respectively), followed by the penultimate syllable, 283 in phrase-final position and 247 in phrase-medial position.. The final syllable is the shortest in both positions, 261ms in the phrase-final position and 179ms in the phrase-medial position. There is no phrase-final lengthening evident here. Lexical stress may have been placed on the initial syllable for the word *flawlessly* both in phrase-final and phrase-medial positions, as the average duration of the initial syllable is the longest in both positions.

Out of the ten words, phrase-final lengthening is seen in four of them. The words are *playfully*, *cheerfully*, *sinfully* and *carefully*. Where the penultimate syllable is longer, in *hopelessly*, *endlessly*, *wilfully* and *flawlessly*, there is a sharper drop in duration between the penultimate and final syllables in phrase-medial position but not in phrase-final position. This reason could be that in phrase-final position, the final syllable is also long, and therefore there is not much of a difference between the last two syllables.

Out of the ten test words, in phrase-final position, the duration of four words show stress placement in the initial syllable, three words show stress placement in the penultimate syllable, and three words appear to have stress placement in the final syllable, based on length of syllable. This is shown in Table 4.3.

Table 4.3: Stress placement in the ten words in Experiment 1 in phrase-final and phrase-medial positions based on syllable duration

No.	Test Word	Stress Placement (Syllable) Based on Duration	
		Phrase-final Position	Phrase-medial Position
1	manfully	initial	initial
2	hopelessly	penultimate	penultimate
3	endlessly	penultimate	penultimate
4	playfully	final	penultimate
5	cheerfully	final	initial
6	sinfully	initial	initial
7	carefully	final	penultimate
8	wilfully	penultimate	penultimate
9	slothfully	initial	initial
10	flawlessly	initial	initial

As for the test words in phrase-medial position, five words appear to be stressed on the initial syllable and five words on the final syllable, based on syllable duration.

The percentage difference was calculated to enable a comparison between ME, SgE and BrE, as explained in 3.4.1, using the average syllable durations of the final and penultimate syllables of all test words across all speakers. In the phrase-final position, the final syllable is 4% longer than the penultimate syllable in ME, a possible evidence of phrase-final lengthening. However, this is much shorter than Low and Grabe's (1999, p. 45) 22% in SgE, but longer than BrE, which was 5% shorter. As for phrase-medial position, the final syllable is the shortest across all three varieties, with ME's -32% being closer to BrE's -41%, compared to SgE's -5%. This means the assumption that ME speakers stress the final syllable may not be accurate. Rather, this could be an effect of phrase final lengthening, which words examined in isolation, for example, a word list, or placed at the end of a phrase, would display (see 1.1; Low & Grabe, 1999).

4.1.2 Fundamental frequency

Apart from duration, the average fundamental frequency (F0) in Hertz (Hz) for each syllable of the ten test words in Experiment 1 were measured at the beginning of the voiced portion of a syllable (onset) and at the end of the voiced portion of a syllable (offset) in the phrase-final and phrase-medial positions (see 3.4.2). This is shown in Table 4.4.

Table 4.4: Average F0 for each syllable in the phrase-final and phrase-medial positions in Experiment 1

Word	Phrase-final position						Phrase-medial position					
	Syllable 1		Syllable 2		Syllable 3		Syllable 1		Syllable 2		Syllable 3	
	Onset	Offset	Onset	Offset	Onset	Offset	Onset	Offset	Onset	Offset	Onset	Offset
1	206	196	204	195	187	165	223	228	254	246	244	260
2	206	192	202	189	167	154	233	214	221	216	222	218
3	201	189	190	185	175	172	216	207	216	212	218	213
4	220	202	209	190	175	170	235	231	243	233	236	235
5	227	199	211	194	191	188	246	234	254	243	252	269
6	223	202	204	188	179	185	249	236	246	234	239	240
7	217	191	187	174	166	183	242	229	253	243	250	257
8	192	187	195	183	174	184	208	222	250	238	245	245
9	208	196	198	170	172	144	228	229	243	233	244	236
10	197	182	183	184	180	162	230	210	230	231	245	241
Average	210	194	198	185	177	171	231	224	241	233	240	241

Figure 4.11 below shows the F0 graphs for the average F0 for each syllable in the ten test words in phrase-final position (on the left) and in phrase-medial position (on the right). The three lines represent the pitch direction of the average onset and offset of F0 of the three syllables.

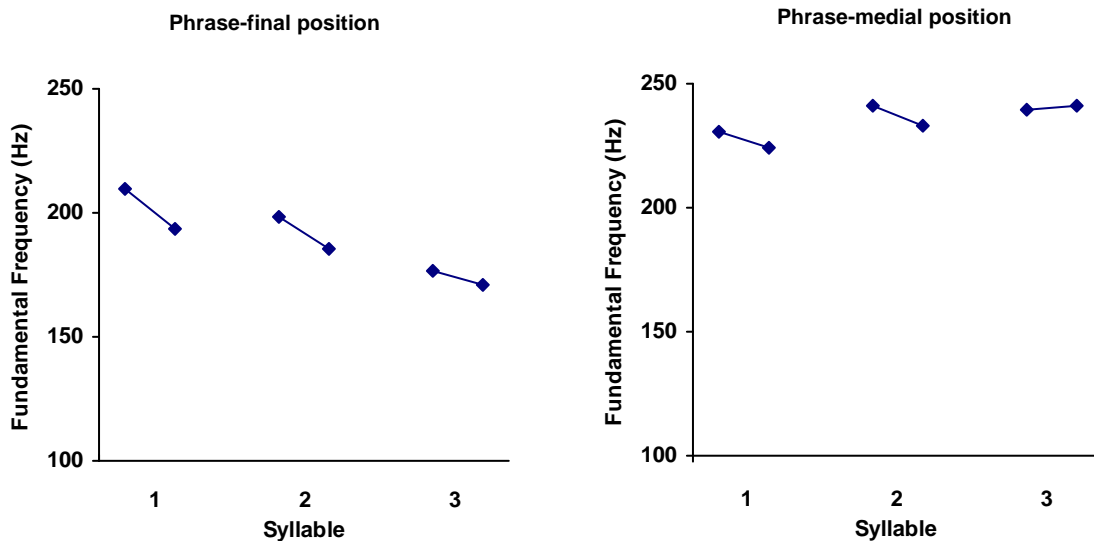


Figure 4.11: Average F0 graph for test words in phrase-final and phrase-medial positions in Experiment 1

The lines in the graph in Figure 4.11 for phrase-final position exhibit a step-down pitch direction in F0 between the first and the following syllables. This suggests that primary stress has been placed on the first syllable because of a higher F0 (see 2.2.3). There is a small step-up between the offset of the initial syllable and the onset of the penultimate syllable. This is a similar pattern observed in SgE but not BrE, according to Low and Grabe (1999). In BrE, Low and Grabe (1999) found a clear step-down in F0 between the offset of the initial syllable and the onset of the penultimate syllable. Between the offset of the penultimate syllable and the onset of the final syllable, ME speakers displayed a clear step-down between the offset and onset, while based on Low and Grabe's (1999, p.

47) F0 findings, SgE and BrE showed very little difference between the F0 offset of the penultimate syllable and the F0 onset of the final syllable.

In the phrase-medial position, there is a step-up in F0 from the offset of the first syllable to the onset of the second syllable. The same step-up can be seen in SgE and BrE (Low and Grabe, 1999, p. 48). There is also a step-up in F0 from the offset of the second syllable to the onset of the final syllable. In BrE and SgE, the same step-up can be observed, although there is a sharper step-down in F0 on the second and the third syllable in BrE (Low and Grabe, 1999, p. 48). The average F0 for each syllable of the ten test words in both phrase-final and phrase-medial positions is illustrated in Figures 4.12 to 4.21.

The average F0 for each syllable in the first word, *manfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.12.

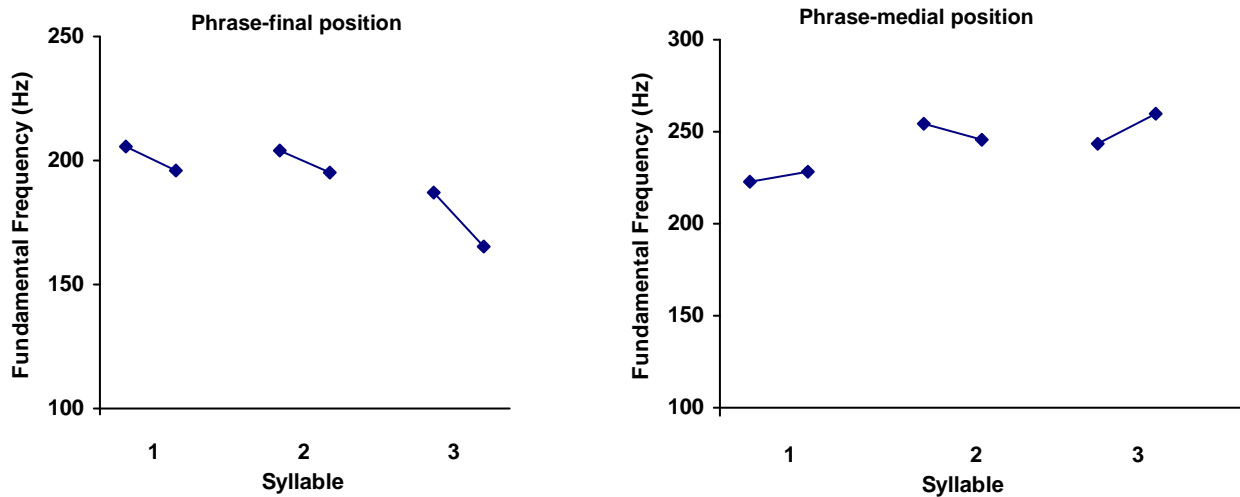


Figure 4.12: Average F0 for each syllable in *manfully* in phrase-final and phrase-medial positions

Figure 4.12 shows that in the phrase-final position, the average F0 of the onset and offset of both the initial and penultimate syllables of the word *manfully* are almost the same. There is a clear step-down in F0 from the offset of the penultimate syllable (195 Hz) to the onset of the final syllable (187 Hz) suggesting that primary stress was not placed on the final syllable but on the initial syllable. In phrase-medial position, a clear step-up can be seen from the offset of the initial syllable to the onset of the second syllable, from 228 Hz to 254 Hz. From the offset of the penultimate syllable to the onset of the final syllable, there is a slight step-down from 246 Hz to 244 Hz. Although it is not immediately clear where stress placement is, it can be assumed that stress is on the final syllable as F0 is the highest in the offset of the final syllable among all three syllables.

The average F0 for each syllable in the second word, *hopelessly*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.13 below.

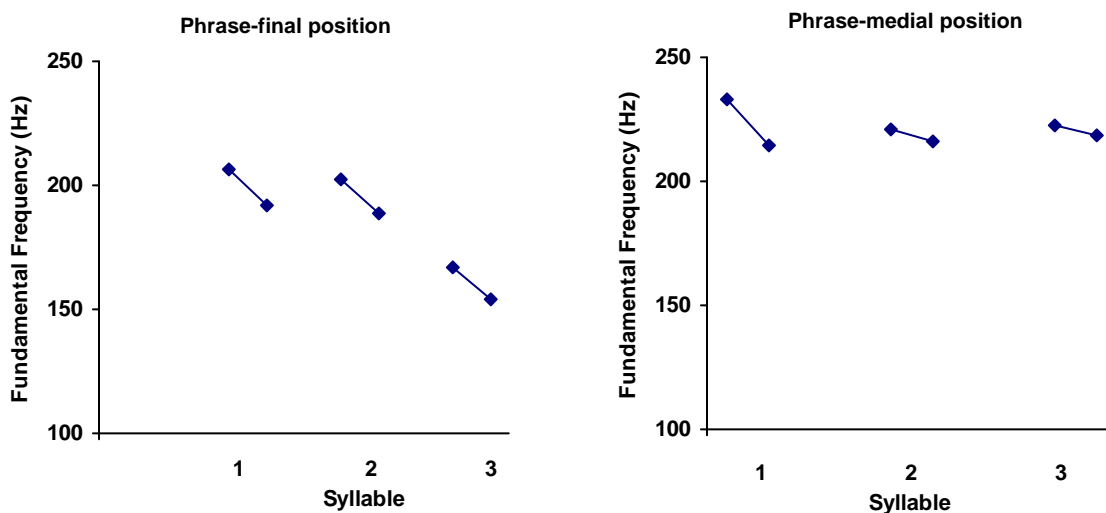


Figure 4.13: Average F0 for each syllable in *hopelessly* in phrase-final and phrase-medial positions

Figure 4.13 shows that in phrase-final position, the average F0 in the word *hopelessly* in the first and penultimate syllables look similar, with the F0 slightly higher in the first syllable. There is a clear step-down from the offset of the penultimate syllable to the onset of the final syllable, from 189 Hz to 167 Hz, suggesting that stress placement is not on the final syllable. Stress may have been placed on the first syllable. In the phrase-medial position, a significant difference between the penultimate and final syllables is not evident. However, it is clear that F0 is the highest in the initial syllable, thus, stress may have been placed on the initial syllable in this position as well as in phrase-final position.

The average F0 for each syllable in the third word, *endlessly*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.14 below.

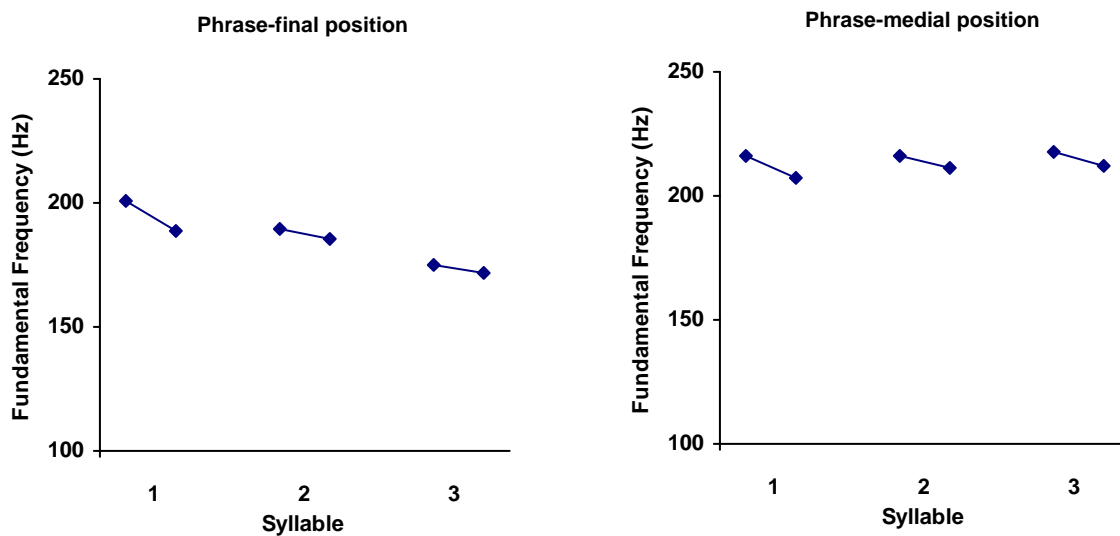


Figure 4.14: Average F0 for each syllable in *endlessly* in phrase-final and phrase-medial positions

Figure 4.14 shows clearly that for the word *endlessly* in phrase-final position, F0 is the highest in the initial syllable, suggesting that stress placement is on the initial syllable.

There is a downward pitch direction in the graph. A step-down can also be seen from the offset of the penultimate syllable to the onset of the final syllable. In phrase-medial position, the pattern looks similar across the three syllables. It is not immediately clear where the stress placement is. F0 in the final syllable appears to be the highest with 218 Hz (onset) and 213 Hz (offset), while the F0 of the penultimate and final syllables are 216 Hz (onset) and 207 Hz (offset), and 216 Hz (onset) and 212 Hz (offset) respectively. These suggest that stress may have been placed on the final syllable.

The average F0 for each syllable in the fourth word, *playfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.15 below.

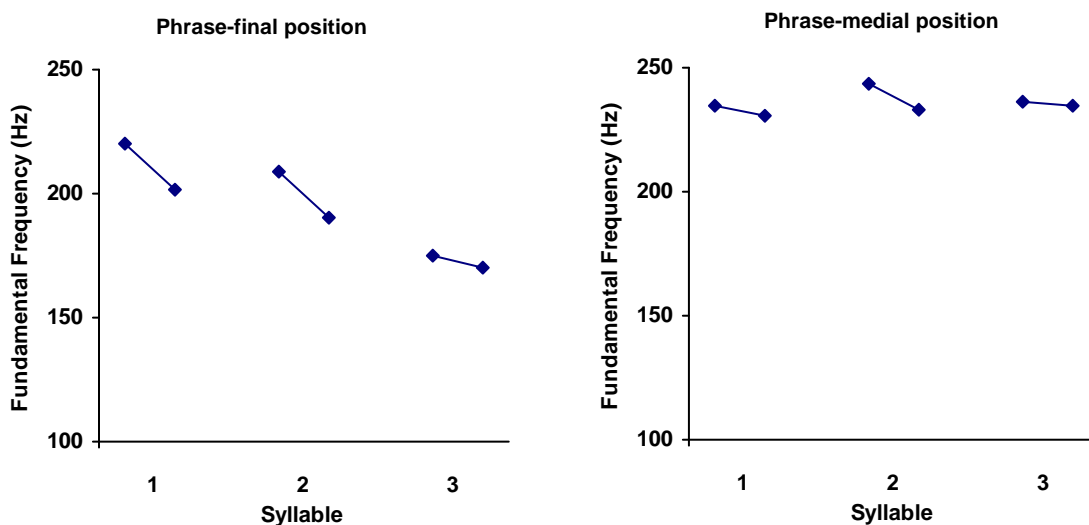


Figure 4.15: Average F0 for each syllable in *playfully* in phrase-final and phrase-medial positions

Figure 4.15 shows that in phrase-final position, the F0 in the word *playfully* exhibits a clear step-down from the offset of the penultimate syllable to the onset of the final syllable. Stress placement appears to be on the initial syllable with a downward pitch

direction. In phrase-medial position, there appears to be a step-up from the offset of the first syllable to the onset of the penultimate syllable, while there is a similar pattern between the first and last syllables. A slight step-up from 233 Hz to 236 Hz can be observed from the offset of the penultimate syllable to the onset of the final syllable. As F0 appears to be the highest in the onset of the penultimate syllable, stress placement could have fallen on the penultimate syllable.

The average F0 for each syllable in the fifth word, *cheerfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.16 below.

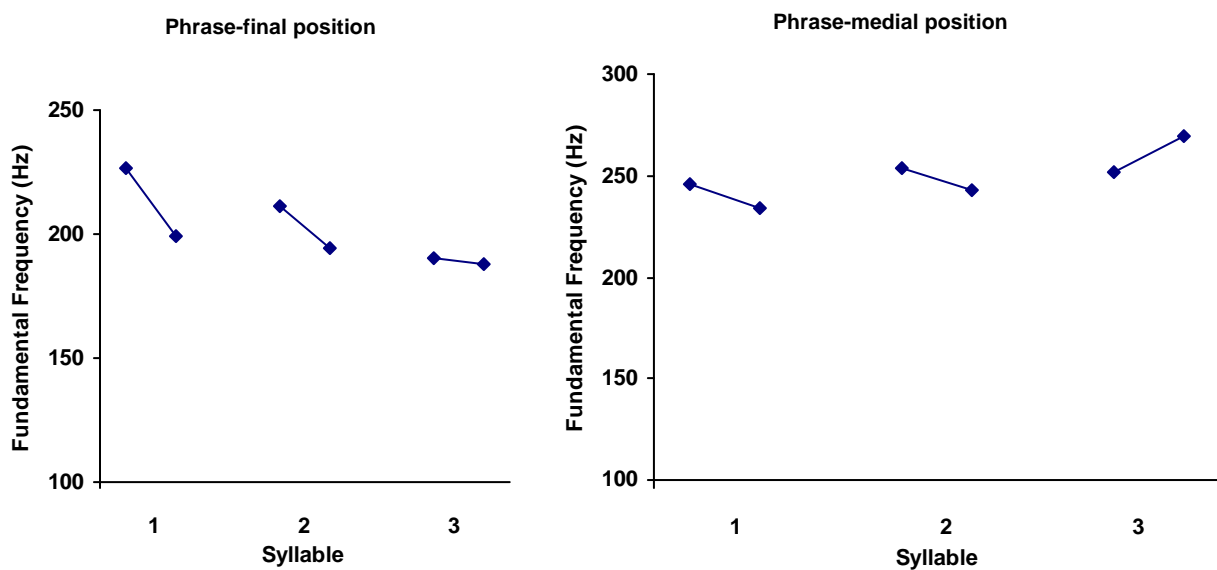


Figure 4.16: Average F0 for each syllable in *cheerfully* in phrase-final and phrase-medial positions

Figure 4.16 shows that in phrase-final position, stress placement in the word *cheerfully* appears to be on the initial syllable. There is a step-down from the offset of the penultimate syllable to the onset of the final syllable, which also has the lowest F0 among all three syllables. This suggests that stress placement is not on the final syllable. In

phrase-medial position, a step-up can be seen from the offset of the initial syllable to the onset of the second syllable, from 234 Hz to 254 Hz. From the offset of the penultimate syllable to the onset of the final syllable, there is a slight step-up from 243 Hz to 252 Hz. This suggests that stress may have been placed on the final syllable.

The average F0 for each syllable in the sixth word, *sinfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.17 below.

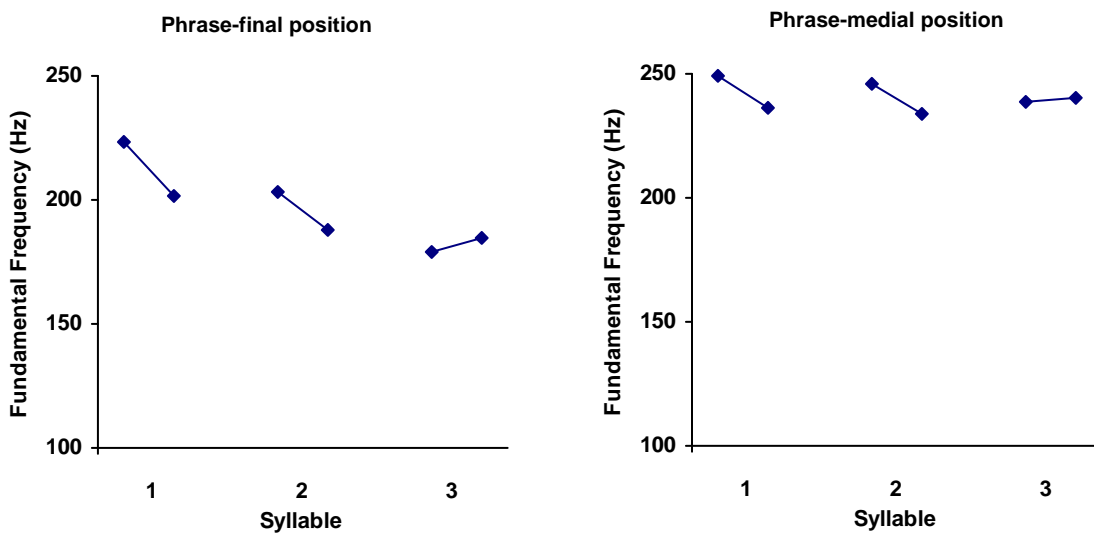


Figure 4.17: Average F0 for each syllable in *sinfully* in phrase-final and phrase-medial positions

Figure 4.17 shows that in phrase-final position, the F0 in the word *sinfully* exhibits a clear step-down from the offset of the penultimate syllable to the onset of the final syllable. Stress placement appears to be on the initial syllable with a downward pitch direction. It is clear that stress is not placed on the final syllable. In phrase-medial position, the pattern looks similar between the first two syllables. It is not immediately clear where

stress placement is, but as the onset of the first syllable has the highest F0 among all three syllables, stress may have been placed on the first syllable.

The average F0 for each syllable in the seventh word, *carefully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.18.

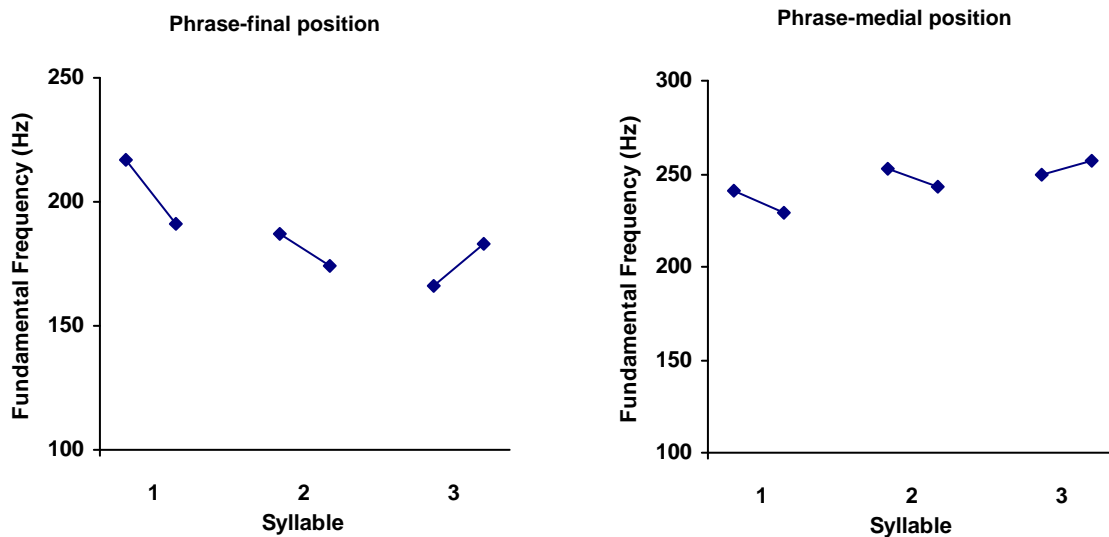


Figure 4.18: Average F0 for each syllable in *carefully* in phrase-final and phrase-medial positions

Figure 4.18 shows that in the phrase-final position, the word *carefully* exhibits a step-down in F0 from the offset of the first syllable (191 Hz) to the onset of the penultimate syllable (187 Hz), as well as from the offset of the penultimate syllable (174 Hz) to the onset of the final syllable (166Hz). Although the F0 of the offset of the final syllable (166 Hz) is higher than its onset (183 Hz), it is still lower than the F0 of the first syllable. Therefore, stress placement appears to have been placed on the first syllable. In phrase-medial position, a clear step-up can be seen from the offset of the initial syllable to the onset of the second syllable, from 229 Hz to 253 Hz. From the offset of the penultimate

syllable to the onset of the final syllable, there is a slight step-up from 243 Hz to 250 Hz. The F0 of the offset of the final syllable is the highest among all three syllables (257 Hz). This suggests that stress may have been placed on the final syllable.

The average F0 for each syllable in the eighth word, *wilfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.19.

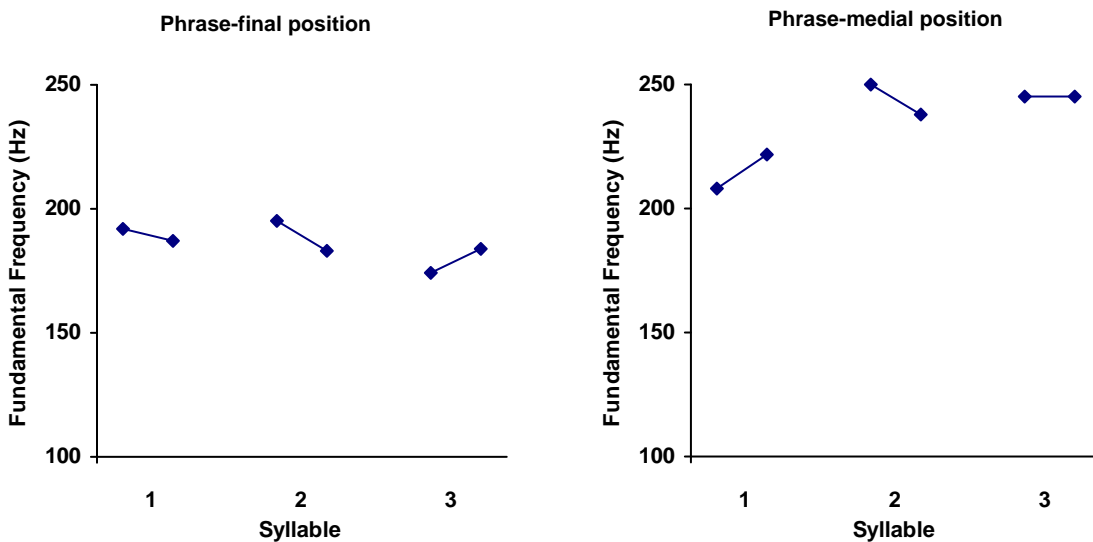


Figure 4.19: Average F0 for each syllable in *wilfully* in phrase-final and phrase-medial positions

Figure 4.19 shows that in the word *wilfully*, there is a higher F0 in the penultimate syllable compared to the other two syllables in the phrase-final position. There is a step-up from the offset of the first syllable (187 Hz) to the onset of the second syllable (195 Hz), while a clear step-down from the offset of the penultimate syllable (183 Hz) to the onset of the final syllable (174 Hz) can be observed. Although the F0 of the offset of the final syllable (184 Hz) is higher than its onset (174 Hz), it is not the highest F0 among the three syllables. Stress appears to have been placed on the penultimate syllable. In phrase-

medial position, there is a sharp step-up from the offset of the first syllable (222 Hz) to the onset of the penultimate syllable (250 Hz). There is a slight step-up between the offset of the penultimate syllable (238 Hz) and the onset of the final syllable (245 Hz), however F0 is still the highest in the penultimate syllable, suggesting that stress placement seems to be on the penultimate syllable.

The average F0 for each syllable in the ninth word, *slothfully*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.20.

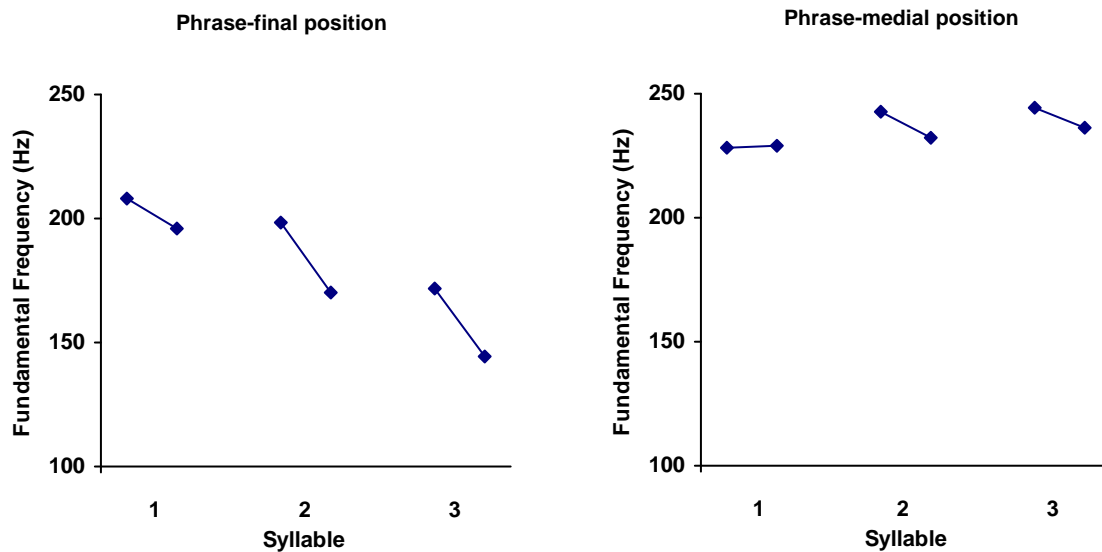


Figure 4.20: Average F0 for each syllable in *slothfully* in phrase-final and phrase-medial positions

Figure 4.20 shows a downward pitch direction in the word *slothfully* in phrase-final position. There is a slight step-up from the offset of the initial syllable (196 Hz) to the onset of the penultimate syllable (198 Hz), as well as from the offset of the penultimate syllable (170 Hz) to the onset of the final syllable (172 Hz). However, it is clear that stress placement is on the initial syllable in phrase-final position. The opposite pitch

direction is seen in phrase-medial position. In phrase-medial position, there is a clear step-up from the offset of the initial syllable (229 Hz) to the onset of the penultimate syllable (243 Hz), as well as from the offset of the penultimate syllable (233 Hz) to the onset of the final syllable (244 Hz). It is not immediately clear where stress placement is as the difference in F0 in the penultimate and final syllables is not significant. As F0 appears to be the highest in the onset of the final syllable, stress placement could have fallen on the final syllable.

The average F0 for each syllable in the tenth and last word, *flawlessly*, in both phrase-final and phrase-medial positions, is illustrated in Figure 4.21.

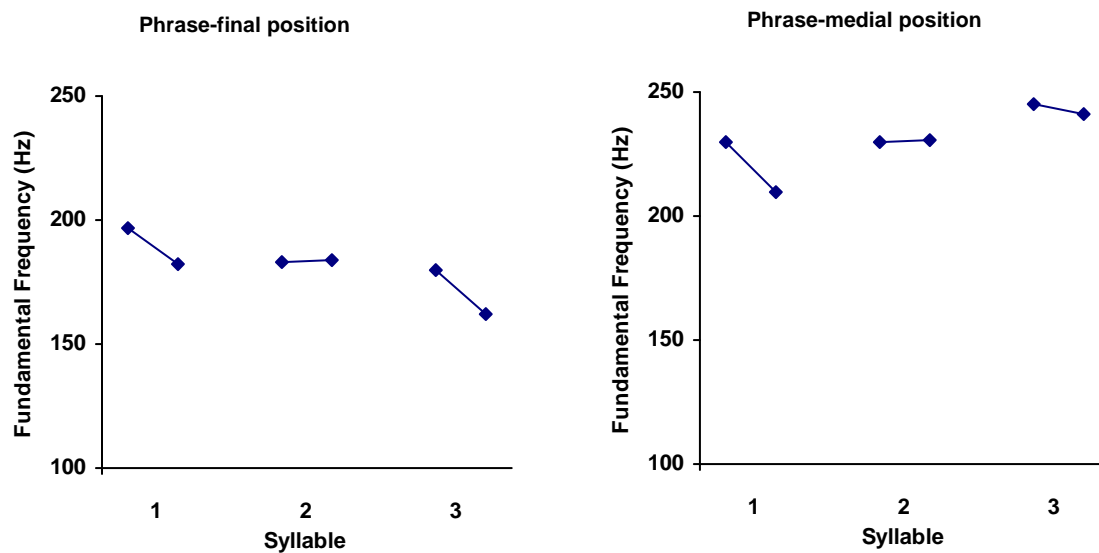


Figure 4.21: Average F0 for each syllable in *flawlessly* in phrase-final and phrase-medial positions

Figure 4.21 shows that in phrase-final position, stress placement in the word *flawlessly* is on the first syllable shown by the downward pitch direction. There is also a slight step-down from the offset of the penultimate syllable to the onset of the final syllable, from 184 Hz to 180 Hz. In phrase-medial position, there is a clear step-up from the offset of the initial syllable (210 Hz) to the onset of the penultimate syllable (230 Hz), as well as from the offset of the penultimate syllable (231 Hz) to the onset of the final syllable (245 Hz). This pattern suggests that stress placement may be on the final syllable for this word in phrase-medial position.

Out of the ten test words, in phrase-final position, the F0 of nine words show stress placement in the initial syllable, while the F0 of *wilfully* show stress placement in the penultimate syllable. This contradicts the assumption that ME speakers stress the final syllable of polysyllabic words. This is shown in Table 4.5.

Table 4.5: Stress placement in the ten words in Experiment 1 in phrase-final and phrase-medial positions based on F0

No.	Test Word	Stress Placement (Syllable) Based on F0	
		Phrase-final Position	Phrase-medial Position
1	manfully	initial	final
2	hopelessly	initial	initial
3	endlessly	initial	final
4	playfully	initial	penultimate
5	cheerfully	initial	final
6	sinfully	initial	initial
7	carefully	initial	final
8	wilfully	penultimate	penultimate
9	slothfully	initial	final
10	flawlessly	initial	final

As for the test words in phrase-medial position, two words were stressed on the initial syllable, two words on the penultimate syllable and six words on the final syllable, based on F0.

4.1.3 A Comparison between Duration and Fundamental Frequency

In this section, stress placement in both phrase-final and phrase-medial positions based on duration and F0, the two correlates of stress, is compared. Table 4.6 compares the stress placement in the ten test words in Experiment 1.

Table 4.6: Stress placement in the ten words in Experiment 1 in phrase-final and phrase-medial positions based on duration and F0

No.	Test Word	Stress Placement (Syllable)			
		Phrase-final Position		Phrase-medial Position	
		Duration	F0	Duration	F0
1	manfully	initial	initial	initial	final
2	hopelessly	penultimate	initial	penultimate	initial
3	endlessly	penultimate	initial	penultimate	final
4	playfully	final	initial	penultimate	penultimate
5	cheerfully	final	initial	initial	final
6	sinfully	initial	initial	initial	initial
7	carefully	final	initial	penultimate	final
8	wilfully	penultimate	penultimate	penultimate	penultimate
9	slothfully	initial	initial	initial	final
10	flawlessly	initial	initial	initial	final

Table 4.6 shows that in phrase-final position, five of the ten words show correlation in stress placement based on duration and F0, namely *manfully*, *sinfully*, *wilfully*, *slothfully* and *flawlessly*. Stress placement is on the penultimate syllable for *wilfully*, and on the initial syllable for other four words. As for the other five words, although the longest duration is on the final or penultimate syllables, the F0 shows that stress placement is placed on the initial syllable for all five words. This suggests that the durational results could be due to phrase-final lengthening.

In phrase-medial position, only two words show correlation in stress placement based on duration and F0, namely *playfully* and *wilfully*, which is on the penultimate syllable. As for the other eight words, based on duration, five words were stressed on the initial syllable and three on the penultimate syllable. Based on F0, six words were stressed on the final syllable while two words were stressed on the initial syllable. One reason correlation was not seen in most of the words is the effect of having a word following the test word in the carrier sentences used in the experiment. Another possible reason for this is that duration and F0 alone may not be indicative of actual stress placement. As can be seen from the comparison of the two data, the indication of stress placement based on duration and the indication of stress placement based on F0 did not produce the same result for every word.

4.2 Findings from Experiment 2

In the second experiment, the duration of the final syllable of a three-syllable word was compared with that of the immediately preceding syllable in one instance only – when the

word is in a phrase-medial position. The F0 of the voiced portions of each syllable was also examined. The results are presented in the following sections.

4.2.1 Duration

The table below shows the difference in average duration in milliseconds (ms) between the penultimate and final syllable of the five test words in phrase-medial position. Similar to Experiment 1 (see 4.1.1), the difference is calculated by subtracting the duration of the penultimate syllable from the duration of the final syllable. A positive value shows that the duration of the final syllable is longer than that of the penultimate syllable, while a negative value denotes a shorter final syllable compared to the penultimate syllable.

Table 4.7: Difference in duration between penultimate and final syllable in Experiment 2

Phrase-medial position	
Word	Difference (ms)
1	52
2	97
3	-40
4	18
5	100
Average	46

Table 4.7 shows that the difference in duration between the penultimate and final syllable of the five test words is 46ms. This result is a contrast to the difference in duration in Experiment 1 in the phrase-medial position, which is -53ms. In this experiment, four

words (1, 2, 4 and 5) have a longer final syllable than the penultimate. The average duration for each syllable in this experiment is shown in Table 4.8.

Table 4.8: Average duration for each syllable in Experiment 2

Phrase-medial position			
Word	Sy1	Sy2	Sy3
1	160	140	192
2	199	111	208
3	131	224	184
4	296	191	209
5	230	130	230
Average	203	159	205

Comparing the average duration for each syllable in Experiment 2 (Table 4.8), the result is again different from the phrase-medial position in Experiment 1. Instead of finding the final syllable shorter than the penultimate, the final syllable is longer than the penultimate, and of almost the same length as the initial syllable. The average duration for each syllable in the five test words is illustrated in Figures 4.22 to 4.26.

The average duration for each syllable in the first word, *emperor*, in phrase-medial position is illustrated in Figure 4.22.

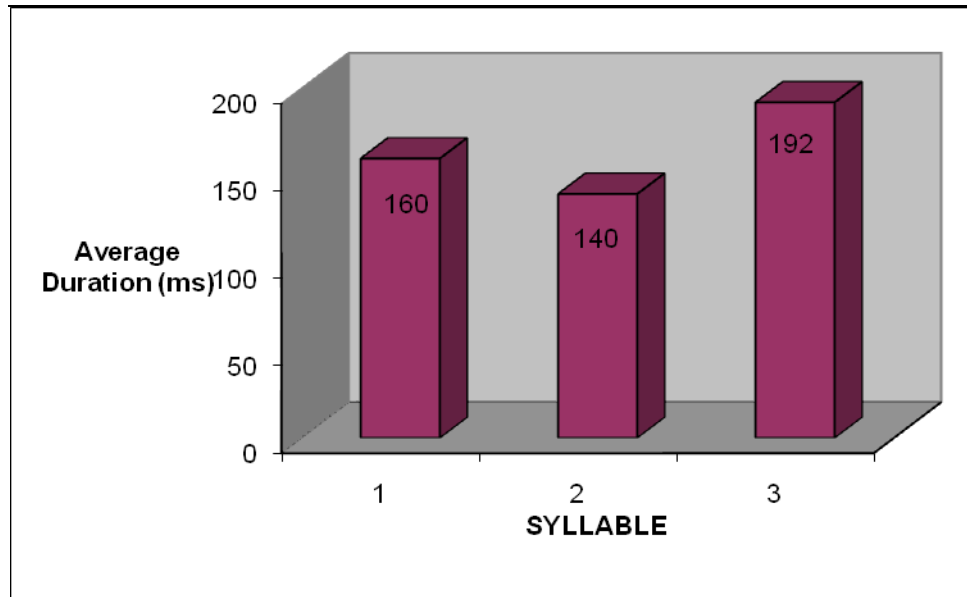


Figure 4.22: Average duration for each syllable in *emperor* in phrase-medial position

Figure 4.22 shows that the final syllable of the word *emperor* has the longest average duration in phrase-medial position (192ms). The penultimate syllable (140ms) is shorter than the first syllable (160ms). The average duration was done based on seven out of ten recordings because it was found that three subjects had pronounced the word *emperor* as a two-syllable word, /em/ + /prɜ/, rather than as a three-syllable word. The durations in Figure 4.22 suggest that lexical stress is placed on the final syllable.

The average duration for each syllable in the second word, *cinema*, in phrase-medial position is illustrated in Figure 4.23.

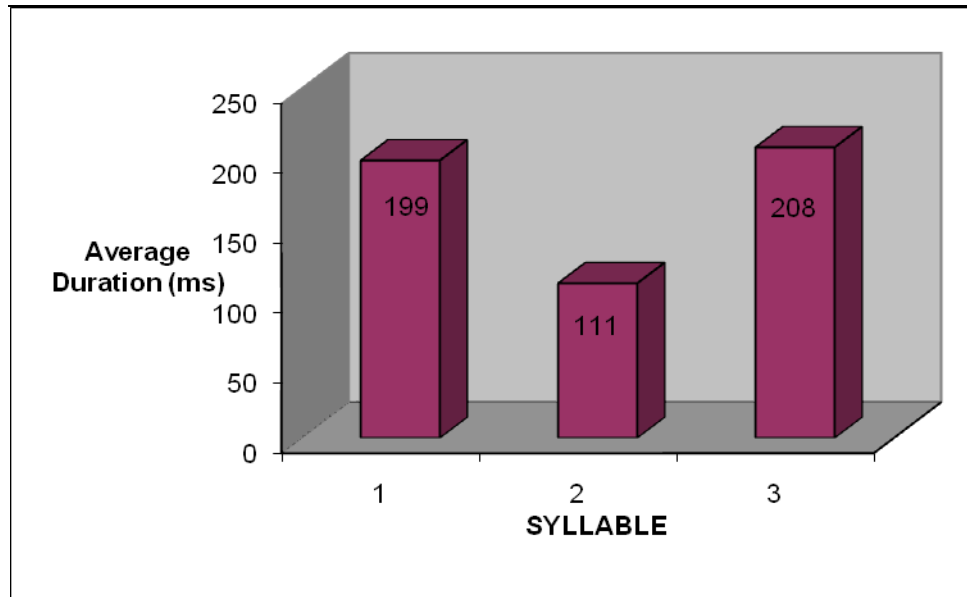


Figure 4.23: Average duration for each syllable in *cinema* in phrase-medial position

Figure 4.23 shows that the final syllable of the word *cinema* has the longest average duration in phrase-medial position (208ms). The initial syllable is the second longest (199ms) while the penultimate syllable is the shortest (111ms). Four speakers had final syllable measurements that were exceptionally longer, namely Speaker 1 (255ms), Speaker 3 (248ms), Speaker 6 (254ms) and Speaker 8 (242ms). If the measurements of these four speakers are removed, the average durations of the initial, penultimate and final syllables are 121ms, 66ms and 108ms respectively. Although the penultimate syllable remains the shortest syllable among the three syllables and is still much shorter than the final syllable, removing the four measurements shows a longer initial syllable, where stress placement should have been. One reason the penultimate syllable is shorter than the final syllable is due to the speakers pronouncing *cinema* as /sɪnɪmə/, the final syllable with the full vowel /ə/, which is longer than the /ɪ/ in the penultimate syllable.

The average duration for each syllable in the third word, *custody*, in phrase-medial position is illustrated in Figure 4.24.

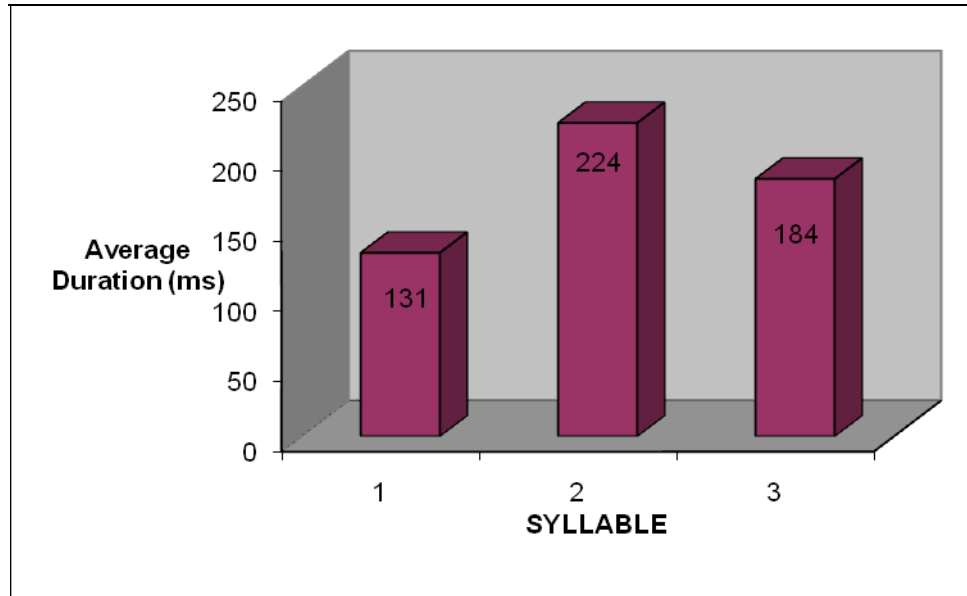


Figure 4.24: Average duration for each syllable in *custody* in phrase-medial position

Figure 4.24 shows that the penultimate syllable in the word *custody* has the longest average duration (224ms) in phrase-medial position. The shortest syllable is the initial syllable (131ms) while the final syllable is the second longest (184ms). Although three speakers recorded exceptionally longer final syllables, removing the measurements from the average duration calculation does not change the pattern as the length of the penultimate syllable is the longest in nine speakers. Thus, the durations in Figure 4.24 suggest that lexical stress is placed on the penultimate syllable.

The average duration for each syllable in the fourth word, *newspaper*, in phrase-medial position is illustrated in Figure 4.25.

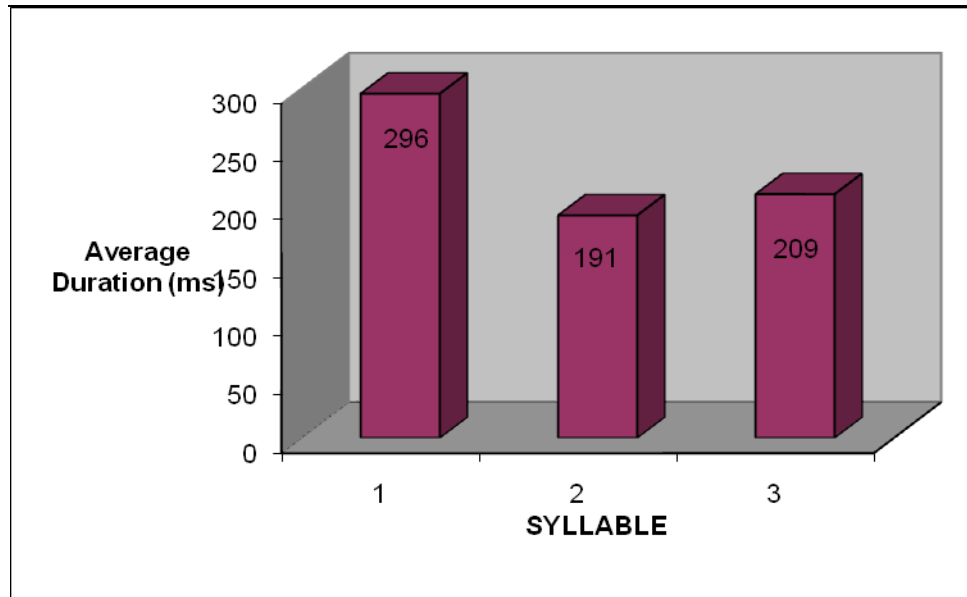


Figure 4.25: Average duration for each syllable in *newspaper* in phrase-medial position

Figure 4.25 shows that the initial syllable in the word *newspaper* has the longest average duration (296ms) in phrase-medial position. The final syllable is expected to be shorter than the penultimate syllable but the contrary is observed, with 209ms and 191ms respectively. Removing three of the longest final syllable durations, namely Speaker 5 (260ms), Speaker 6 (258ms) and Speaker 8 (252ms), shows no difference in average duration between the penultimate and final syllables. After removing these three measurements, the average duration of the initial, penultimate and final syllables are 196ms, 132ms and 132ms, respectively. The initial syllable is still the longest, where lexical stress has been placed.

The average duration for each syllable in the fifth and final word, *gentlemen*, in phrase-medial position is illustrated in Figure 4.26.

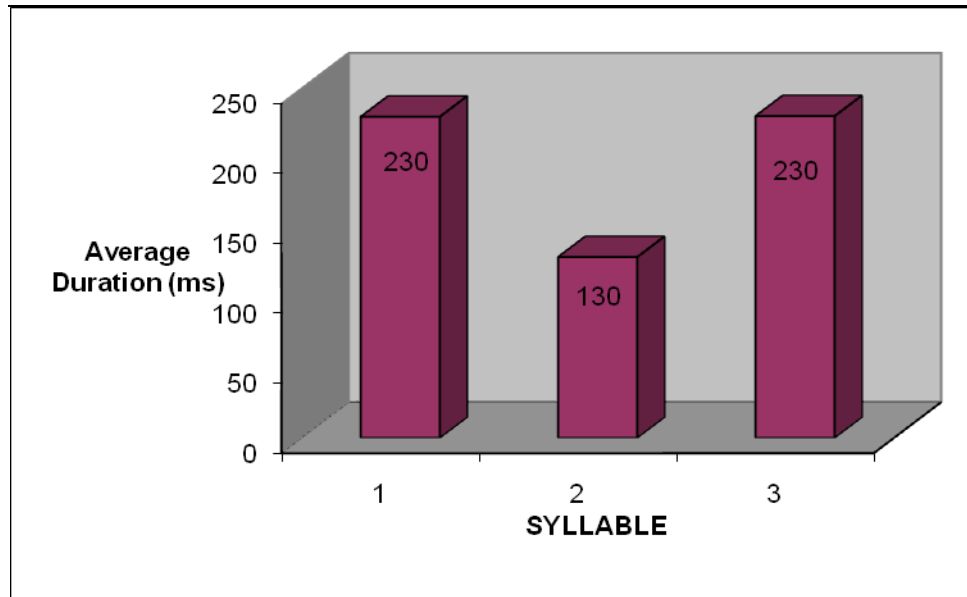


Figure 4.26: Average duration for each syllable in *gentlemen* in phrase-medial position

Figure 4.26 shows that the initial and final syllables in the word *gentlemen* have the same average duration (230ms), which is longer than the penultimate syllable (130ms). However, the final syllable could have been shorter than the initial syllable if the measurements of three speakers were removed, namely Speaker 1 (301ms), Speaker 3 (274ms) and Speaker 6 (299ms). When removed, the average durations for the initial, penultimate and final syllables are 156ms, 87ms and 143ms respectively, which shows a shorter final syllable compared to the initial syllable, suggesting that lexical stress is placed on the first syllable.

Out of the five test words, based on average duration, two words were stressed on the initial syllable (*newspaper* and *gentlemen*), one word was stressed on the penultimate syllable (*custody*) and two words were stressed on the final syllable (*emperor* and

cinema), although the initial syllable was expected to be stressed in all five words. Table 4.9 shows the stress placement based on average duration.

Table 4.9: Stress placement in the five words in Experiment 2 in phrase-medial position based on duration

No.	Test Word	Stress Placement (Syllable) Based on Duration
		Phrase-medial Position
1	emperor	final
2	cinema	final
3	custody	penultimate
4	newspaper	initial
5	gentlemen	initial

4.2.2 Fundamental frequency

Fundamental frequency (F0), another correlate of stress, is measured and its measurement examined. Table 4.10 shows the average F0 in Hz for each syllable of the five test words in Experiment 2 measured at the beginning of the voiced portion of a syllable (onset) and at the end of the voiced portion of a syllable (offset) in the phrase-medial position (see 3.4.2). The graph is illustrated in Figure 4.27.

Table 4.10: Average F0 for each syllable in Experiment 2

Word	Syllable 1		Syllable 2		Syllable 3	
	Onset	Offset	Onset	Offset	Onset	Offset
1	198	168	214	201	198	168
2	235	210	210	206	206	173
3	229	216	222	195	210	192
4	215	236	225	202	206	184
5	211	195	203	206	206	162
Average	218	205	215	202	205	176

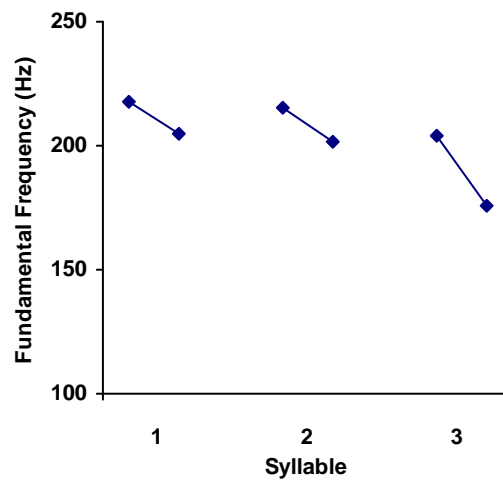


Figure 4.27: Average F0 graph for test words in Experiment 2

The average F0 graph for the test words in phrase-medial position in this experiment shows a downward pitch direction. It is not immediately clear where stress placement is, but as the onset of the first syllable has the highest F0, stress could have been placed on the first syllable. The average F0 for each syllable of the five test words in phrase-medial position is illustrated in Figures 4.28 to 4.32.

The average F0 for each syllable in the first word, *emperor*, in phrase-medial position, is illustrated in Figure 4.28.

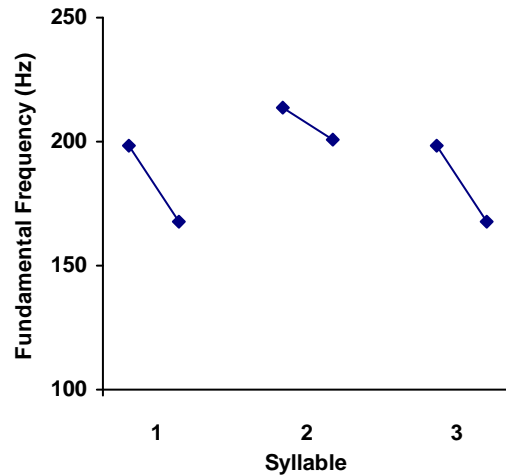


Figure 4.28: Average F0 for each syllable in *emperor* in phrase-medial position

Figure 4.28 shows that in the word *emperor*, there is a higher F0 in the penultimate syllable compared to the other two syllables in the phrase-medial position. The average F0 was done based on seven recordings, as three subjects pronounced the word *emperor* as a two-syllable word. There is a clear step-up from the offset of the first syllable (168 Hz) to the onset of the second syllable (214 Hz), while a small step-down can be observed from the offset of the penultimate syllable (201 Hz) to the onset of the final syllable (198 Hz). Stress appears to be placed on the penultimate syllable.

The average F0 for each syllable in the second word, *cinema*, in phrase-medial position, is illustrated in Figure 4.29.

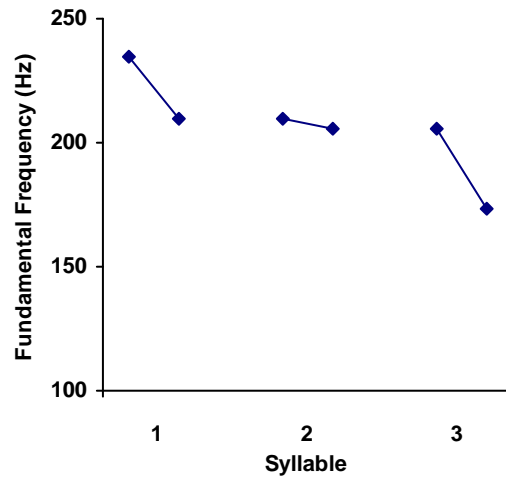


Figure 4.29: Average F0 for each syllable in *cinema* in phrase-medial position

Figure 4.29 shows that based on F0, stress placement is on the first syllable of the word *cinema* in phrase-medial position, with 235 Hz on the onset and 210 Hz on the offset of the syllable. No step-up or step-down can be observed from the offset of the first syllable (210 Hz) to the onset of the penultimate syllable (210 Hz), and the same is observed in the offset of the penultimate syllable (206 Hz) to the onset of the final syllable (206 Hz).

The average F0 for each syllable in the third word, *custody*, in phrase-medial position, is illustrated in Figure 4.30.

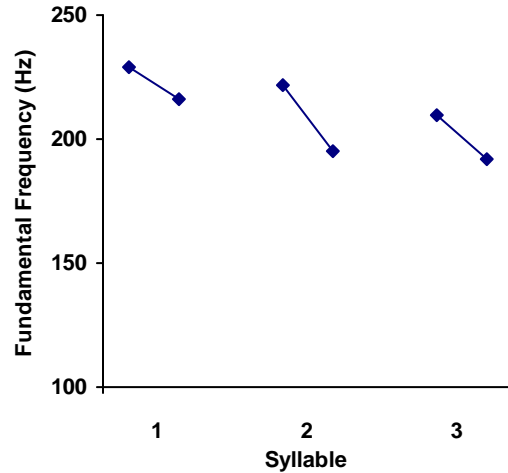


Figure 4.30: Average F0 for each syllable in *custody* in phrase-medial position

Figure 4.30 shows that based on F0, stress placement is on the first syllable of the word *custody* in phrase-medial position, with 229 Hz on the onset and 216 Hz on the offset of the syllable. There is a step-up from the offset of the first syllable (216 Hz) to the onset of the second syllable (222 Hz). Another clear step-up can be observed from the offset of the penultimate syllable (195 Hz) to the onset of the final syllable (210 Hz).

The average F0 for each syllable in the fourth word, *newspaper*, in phrase-medial position, is illustrated in Figure 4.31.

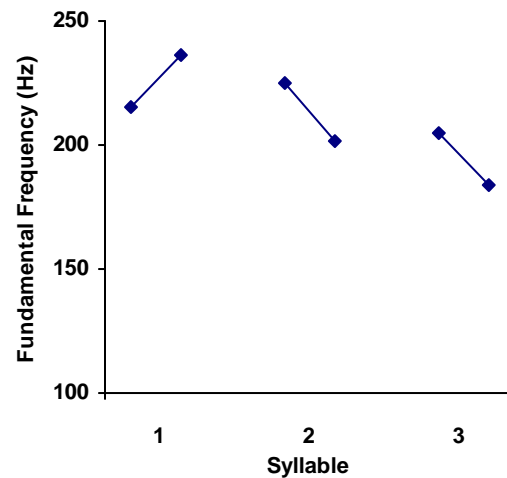


Figure 4.31: Average F0 for each syllable in *newspaper* in phrase-medial position

Figure 4.31 shows that in the word *newspaper*, there is a higher F0 in the first syllable compared to the other two syllables in the phrase-medial position. There is a step-down from the offset of the first syllable (236 Hz) to the onset of the second syllable (202 Hz), while a small step-up can be observed from the offset of the penultimate syllable (202 Hz) to the onset of the final syllable (206 Hz). Stress appears to be placed on the first syllable, based on the highest F0.

The average F0 for each syllable in the fifth and final word, *gentlemen*, in phrase-medial position, is illustrated in Figure 4.32.

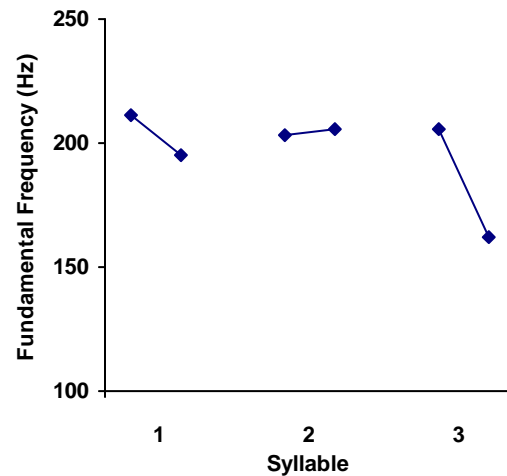


Figure 4.32: Average F0 for each syllable in *gentlemen* in phrase-medial position

Figure 4.32 shows that in the word *gentlemen*, there is a higher F0 in the first syllable compared to the other two syllables in the phrase-medial position. There is a step-up from the offset of the first syllable (195 Hz) to the onset of the second syllable (203 Hz), while no step-up or step-down can be observed from the offset of the penultimate syllable (206 Hz) to the onset of the final syllable (206 Hz). Stress appears to be placed on the first syllable, based on the highest F0.

Out of the five test words, based on F0, four words were stressed on the initial syllable (*cinema*, *custody*, *newspaper* and *gentlemen*), and one word was stressed on the penultimate syllable (*emperor*), although the initial syllable is expected to be stressed in all five words. Table 4.11 shows the stress placement based on average F0.

Table 4.11: Stress placement in the five words in Experiment 2 in phrase-medial position based on F0

No.	Test Word	Stress Placement (Syllable) Based on F0	
		Phrase-medial Position	
1	emperor	penultimate	
2	cinema	initial	
3	custody	initial	
4	newspaper	initial	
5	gentlemen	initial	

4.2.3 A Comparison between Duration and Fundamental Frequency

In this section, stress placement in phrase-medial position based on duration and F0, the two correlates of stress, is compared. Table 4.12 compares the stress placement in the five test words in Experiment 2.

Table 4.12: A comparison of stress placement in the five words in Experiment 2 in phrase-medial position based on duration and F0

No.	Test Word	Stress Placement (Syllable) Based on	
		Duration	F0
1	emperor	final	penultimate
2	cinema	final	initial
3	custody	penultimate	initial
4	newspaper	initial	initial
5	gentlemen	initial	initial

Table 4.12 shows that two of the five words show correlation in stress placement based on duration and F0, namely *newspaper* and *gentlemen*. Stress placement is on the initial syllable for *newspaper* and *gentlemen*. It appears that the morphological make-up for the words used in this experiment played a role in the stress placement of the words *newspaper* and *gentlemen*. Out of the five test words, only these two are compound words, that is *news + paper* and *gentle + men*. For the word *emperor*, stress placement is on the final syllable based on duration, while stress is on the penultimate syllable based on F0. As for the other two words, *cinema* and *custody*, although the longest duration is on the final and penultimate syllables respectively, the F0 shows that stress placement is placed on the initial syllable for both words.

4.3 Conclusion

In conclusion, the results of Experiment 1 show that based on average duration, ME speakers exhibit phrase-final lengthening, which is expected when test words are placed in a phrase-final position. In phrase-medial position, the average duration of the difference between penultimate and final syllables show a shorter final syllable compared to the penultimate syllable, suggesting that ME speakers do not stress the final syllable of polysyllabic words. The difference between the duration of the penultimate syllable and the final syllable in both phrase-final and phrase-medial positions is closer to BrE than SgE.

Based on average F0, ME speakers seem to place stress placement on the initial syllable in phrase-final position but on the final syllable in phrase-medial position. A possible

reason for this is the effect of having a word following the test word in the carrier sentences used in the experiment. Another possible reason for this is that duration and F0 alone may not be indicative of actual stress placement, as correlation in both data was only seen twice in the experiment in phrase-medial position.

In Experiment 2, the average duration between the penultimate and final syllables show that the duration of the final syllable is longer than the penultimate syllable, although test words were in phrase-medial position. This could be due to the different types of words (in morphological make-up) used in the experiment. On the other hand, the average F0 shows that stress placement was on the initial syllable.

In the following chapter, aside from discussing the implications for the findings, suggestions for further research will also be put forth.