

Prosodic Changes Caused by Emphasis in English in Connection with Compensation: A Case in Affirmative Yes-No Questions

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英語の強調発話が反映する韻律変化と補償 —肯定 Yes-No 疑問文の事例—

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要 旨

英語母語話者が、3項または4項から成り、3種類の文法構造を有する肯定 Yes-No 疑問文を対象に、各項を強調して発話した。そして文の全長、および強調された項の、長さ・高さ・強さの変化等の韻律特徴を音声分析ソフトを用いて計測・分析した。強調は、音の高さ変化に増幅したかたちで最も顕著に反映された。ある項を強調するひとつの手段として、ポーズの使用があるが、調査結果より、その挿入箇所が予測可能であることが判明した。文の左端または右端の項を強調する場合は、それぞれその直後、直前にポーズが置かれる。というのも、ポーズの挿入によって一連の発話音声が中断され、それがポーズに隣接する項の音調を孤立させるが、その孤立音調こそが卓立を生じるからである。Yes-No 疑問文においては、主語と動詞の文法的（連語上の）結びつきは、左端の項（助動詞）と主語との結びつきや、動詞と引き続く項（補語や目的語）との結びつきより、弱いため、主語や述語（動詞）を強調する場合は、いずれもポーズは主語と動詞の間に置かれることになる。また、強調された項の位置による韻律特徴の増幅については、左端の先頭項がその程度においても、増幅する韻律特徴の数においても最も顕著になった。文の長さについては、いかなる強調発話であっても、常に中立発話よりも長くなることが観察された。中には、強調と共に、ある韻律特徴の値が中立発話時よりも小さくなることもあったが、その際には必ず基本周波数曲線に変化が生じており、ピッチの変化の方向も、強調を反映する重要な韻律特徴の一つであることが示唆された。すべてのデータをまとめると、強調は本稿で扱った何らかの韻律特徴の増大として74%という確率で現れ、そしてそれらの増大分は73%という確率で他項の韻律特徴の減少として補償された。

1. Introduction

The author has been researching how the prominence was reflected in prosodic features such as pitch, duration, and intensity when a constituent of a sentence was uttered emphatically, by using various types of English sentences. A series of the researches done by Ichizaki (2003, 2004a, 2004b, and 2005) dealt with three kinds of affirmative and negative declarative sentences whose sentence patterns were I, II, and III, while the present paper deals with affirmative Yes-No questions which were the interrogative of the sentences in the preceding researches. The detailed objective data and results will be reported here, and it is hoped that the production of the present paper would be a model to follow in communication for those who learn English when they need some emphasis in their utterance.

2. Investigation and Analysis

2.1 sentences for analysis

Sentences for the investigation consisted of just a few words to obtain clearer and simpler results. Three kinds of affirmative Yes-No questions whose sentence pattern was I, II, and III were adopted for the investigation. For each sentence, i.e. a neutral utterance, the sentence one of whose constitutions was emphasized was prepared as an emphasized utterance. Therefore, the number of emphasized utterances coincided with the number of constituents of the sentence. All the sentences for analysis, with the bold letters indicating the syllables emphasized, were as follows:

group A:

- 1) *Do memories remain?*
- 2) **Do** *memories remain?*
- 3) *Do* **memories** *remain?*
- 4) *Do memories* **remain?**

group B:

- 5) *Are men animals?*
- 6) **Are** *men animals?*
- 7) *Are* **men** *animals?*
- 8) *Are men* **animals?**

group C:

- 9) *Does Eddie love apples?*
- 10) **Does** *Eddie love apples?*
- 11) *Does* **Eddie** *love apples?*
- 12) *Does Eddie* **love** *apples?*
- 13) *Does Eddie love* **apples?**

2.2 subjects

Two native speakers of English served as subjects. Both of them teach English conversation mainly at a Japanese college. The details of them are as follows:

Table 1: Details of Informants

Max. press. means the maximum value of sound pressure level (which could be substituted for sound pressure) and is represented as a minus value because the sound analyzing software used in the present paper sets no sound as -60dB and the maximum value that the software can analyze as 0dB on the display.

initial	sex	age	nationality	native place	register (Hz)	max.press. (dB)
R. B.	male	58	U. K.	Somerset	57-219	-11
D. L.	male	53	U. S. A.	California	97-280	-15

2.3 procedure

The subjects were shown the above phonetic materials and were asked to pronounce them three times for each sentence with the speed and natural manner of their daily speech. Their utterances were recorded onto mini-disk with a microphone. After the recording their utterances were played and they were asked to choose the one utterance out of three that sounded most natural to their ears, and then the chosen utterance was adopted for the analysis using sound analyzing software called *SUGI Speech Analyzer* (Sugito, 2000). The items measured were: the duration of the whole sentence, the duration of each word, the duration of pause if there was one, the highest pitch of the word, the pitch change of the word, the maximum sound pressure level of the word, and the pressure change of the word. Also, the contour of the fundamental contour (F_0 henceforth) was carefully identified.

The results were represented in Table 2-1, 2-2 for group A; 3-1, 3-2 for group B; and 4-1, 4-2 for group C. Since the whole duration of a neutral utterance and that of an emphasized utterance were naturally different, the latter was intentionally adjusted to the former, a provisional whole duration of the emphasized utterance was made and it was listed as the whole duration of a dummy sentence No. x'. The durations of the other words and pauses in the latter were also changed to the provisional values by using the ratio obtained in the adjustment so as to check how much a certain syllable or word was lengthened or shortened with emphasis. Thus, in the following section, discussion on the comparison of duration between a neutral utterance and an emphasized utterance was based on the provisional values mentioned above. With regard to pitch, one tenth of the register was taken as a change of 10% since each informant had his own register as shown in Table 1. Thus, a 10% pitch change of R. B. and D. L. was 16.2Hz and 18.3Hz, respectively. The sound pressure level analyzed with *SUGI Speech Analyzer* was represented in the range of -60dB to 0 dB on the display. Since there was always some noise made by the personal computer when analyzing, the range of 10 dB was reckoned for the noise. Therefore, not -60dB but -50dB was recognized as the minimum value of sound pressure level of every speaker for convenience' sake. As done for pitch, the value of one tenth of the range in sound pressure level of each speaker was recognized as his 10% sound pressure. Thus, a 10% sound

pressure of R. B. and D. L. was 3.9dB and 3.5dB, respectively. In Table 2-2, 3-2, and 4-2, therefore, the symbols for pitch and sound pressure level were decided on the basis of such values representing a 10% change.

3. Results and Remarks

The following discussion relates to Table 2-2, 3-2, and 4-2 for the three groups of sentences, for each subject.

group A ;

R. B.'s emphasis on *Do* in sentence 2) was reflected as a remarkable increase in duration, pitch, and pitch change and some increase both in sound pressure level and its change. A clear compensation was recognized with the following constituent memories in pitch and there was some compensation in the other prosodic features measured. As for emphasized *memories* in sentence 3) a considerable increase was noticed in both duration and pitch change, then some increase was noticed in pressure change, and then there was a slight increase in pressure while there was little change in pitch. A clear compensation was not recognized in pressure change while some compensation was recognized in the other prosodic features. The emphasis on *remain* in sentence 4) was somewhat reflected in duration, then slightly reflected in both pitch and pitch change while little change was noticed in either pressure or pressure change. The positive change was compensated in both duration and pitch change while no compensation was recognized in pitch.

It was duration, pitch change, and possibly pitch that reflected his emphases well and the other features also reflected them reasonably. Compared with the numbers of prosodic features which reflected his emphases with a 10% or more positive change, there were five out of five for *Do*, four out of five for *memories*, and three for *remain*. The numbers might suggest the emphasis on a leftward constituent is better reflected as greater increase or more increases in prosodic features.

D. L.'s emphasis on *Do* in sentence 2) was very strongly reflected as a 110% remarkable increase in duration, and strongly reflected in both pitch change and pressure change, and somewhat reflected in pitch while little change was noticed in pressure. A compensation was recognized in both duration and pitch while no compensation was recognized in either pitch change or pressure change. His emphasis on *memories* in sentence 3) was remarkably reflected in both pitch change, well reflected in pressure change, and then somewhat reflected in duration while little change was noticed in either pitch or pressure. No compensation at all was recognized in any prosodic features. The emphasis on *remain* was remarkably reflected in pitch change and somewhat reflected in pitch while little change was noticed in the other features. A positive change in pitch was compensated while that in pitch change was not.

There were three peculiarities in the emphasized utterances of D. L. It was pitch change that represented his emphases most. The pitch change of every emphasized syllable of his showed with a more than 50% increase compared with the value of his neutral utterance. In contrast, the values of the max sound pressure level of emphasized syllables showed only little change. Besides, he put a pause in sentence 2) and sentence 4),

which broke off the successive F₀ contour identified in his neutral utterance and showed up the isolation of the contour of *Do* in 2) and *remain* in 4).

There were a few points which were recognized in the emphasized utterances of both subjects. The durations of all emphasized utterances were greater than those of their neutral utterances. The first constituent, *Do*, of the sentence was clearly represented with more positive changes in every prosodic feature, which suggested that the first item of the sentence could be visibly identified most easily in the analysis by using sound analyzing software when emphasized. Moreover, the emphasis on the leftward constituent had more prosodic features in which more increase in values was noticed. Comparing the numbers of prosodic features which reflected his emphases with a 10% or more positive change, there were four out of five for *Do*, three out of five for *memories*, and two for *remain*.

group B ;

R. B.'s emphasis on *Are* in sentence 6) was well represented in every prosodic feature. It was outstandingly reflected in pitch with a 210% increase, strongly reflected in duration and pressure change, considerably reflected in both pitch and pressure change, and somewhat reflected in pressure. All the positive changes were compensated to varying degrees, but without any exception. His emphasis on *men* in sentence 7) was remarkably reflected in duration, well reflected in both pitch change and pressure change while little or no change at all was noticed in the remaining prosodic features. A compensation was recognized in both duration and pressure change while there was no compensation in pitch change. As for the emphasis on *animals* in sentence 8), there was a slight negative change in duration and no change at all was noticed in the other prosodic features. Then, how did R. B. emphasize the constituent? The answer was recognized on the F₀ contour of the utterance of sentence 8). The contour started at 115Hz and slightly raised until the end of *men* to 190Hz, then it suddenly fell down to 129Hz at the beginning of *animals* while the contour of his neutral utterance had no gap in pitch between *men* and *animals*. Both F₀ contours were shown in Figure 1 (sentence 5)) and Figure 2 (sentence 8)). A dive in pitch between the constituents seems to have made the following constituent prominent in this case.

It was in duration, pitch change, and pressure change that R. B.'s emphases were well reflected. There was a tendency that a rightward constituent showed less positive change in prosodic features. Comparing the numbers of prosodic features which reflected his emphases with a 10% or more positive change, there were five out of five for *Are*, three out of five for *men*, and none for *animals*.

D. L.'s emphasis on *Are* was outstandingly reflected in duration with a 182% increase, remarkably reflected in pressure change, and well reflected in both pitch and pitch change. The increases in duration and pressure change were clearly compensated while the increases in the other features were never compensated. For the emphasis on *men* only pitch change and pressure change showed a slight increase and no other features showed any change. The prominence of *men* was also recognized on the F₀ contour as was done in R. B.'s utterance of sentence 8). In addition to the separation by the pause of 128ms inserted between *men* and *animals*, the F₀ contour of *men* was quite different for 7) and 5). The *men* in 7) showed a rise-fall while the *men* in 5) showed a rising tone. The emphasis on *animals* was somewhat reflected in pitch change and

pressure change and slightly reflected in pitch while little change was noticed in the remaining features. No compensation was recognized for such increases.

It was in pressure change and pitch change that his emphases were greatly reflected. As for emphasized *Are*, clearer increases were noticed in the other prosodic features except sound pressure level while the emphases on the remaining two constituents showed smaller increases in features. Since it seems that three pauses used by D. L. for all his emphasized sentences had quite a little influence on the production of prominence, it is difficult to say how much his emphases depended upon duration. Comparing the numbers of prosodic features which reflected his emphases with a 10% or more positive change, there were four out of five for *Are*, two out of five for *men*, and three for *animals*.

Every emphasized utterance done by both subjects showed a longer duration than their neutral utterances. For both subjects, the emphasis on the leftward constituent *Are* seems to be most reflected in prosodic features. Moreover, the emphases of both subjects were least reflected in sound pressure level compared with the changes in the other prosodic features.

group C ;

R. B.'s emphasis on *Does* in sentence 10) was remarkably reflected in duration with a 100% increase. The emphasis was also well reflected in the other four features. At the same time every increase was compensated with decrease in other constituent(s). His emphasis on *Eddie* in sentence 11) was clearly reflected in duration and slightly reflected in both pitch change and pressure while it was represented with a little negative change in pitch. The degree of compensation in duration was slight. The F₀ contour of *Eddie* showed a falling tone while that in neutral utterance was a gentle rising. The emphasis on the third constituent *love* was reflected in all prosodic features measured. A great increase of 103% was noticed in duration, there was a clear increase in pitch change, some increase in pressure change, and a slight increase in the other features. The increase in duration was compensated while the other increases were not. Although the emphasis on *apples* was represented as a slight decrease in duration, it was reflected in the remaining features. It was reflected remarkably in pitch change, well reflected in pitch, and more or less reflected in pressure and pressure change. None of the increases were compensated.

Comparing the numbers of prosodic features which reflected his emphases with a 10% or more positive change, there were five, with greater rates, out of five for *Does*, three out of five, with one negative change, for *Eddie*, five out of five for *love*, and four out of five, with one negative change, for *apples*. It was found that the emphasis on the first constituent was also salient in this sentence and the emphases on the following constituent equally well reflected in the prosodic features measured. The emphases in sentence group C were getting reflected in pitch change and were somewhat reflected in the other features although there were two slight negative changes.

D.L.'s emphasis on *Does*, excluding a slight fall in pitch, was reflected remarkably in duration with a 107% increase, strongly reflected in pressure change, somewhat reflected in pitch change, and slightly reflected in pressure. The increase in duration and pitch change was compensated while the increase in pressure change was not. Observing the F₀ contour of *Does*, it became a falling tone while the contour in the

neutral utterance was a gentle rising. Also, a pause was inserted after *Does*, which made the contour of *Does* isolated and prominent. The emphasis on *Eddie* showed a slight decrease in pitch and little changes in the other three features although in pitch change there was a strong compensated increase. The F₀ contour of *Eddie* showed a salient rise-fall with the other constituents being almost level tone. The emphasis on *love* appeared as a clear increase in pitch change, some increase in duration, and a slight increase in pitch and pressure change. The increases in pitch change and duration were compensated. The F₀ contour of *love* became an isolated rising tone, after which another rising for *apples* followed. The emphasis on *apples* showed a quite different result from the results above mentioned. There was a 25% decrease in pitch change and there was little change in the remaining features. D. L. inserted a pause as long as 504ms just before *apples*, which made the rise-fall F₀ contour of *apples* isolated and prominent. The influence of the pause seems to have caused the different result.

Comparing the numbers of prosodic features which reflected his emphases with a 10% or more positive change, there were four out of five, with one negative change, for *Does*, two out of five, with one negative change, for *Eddie*, four out of five for *love*, and none of five, with one negative change, for *apples*. It could be said that the emphasis on the first constituent *Does* appeared with clearer increases in the prosodic features. D. L.'s emphases most depended on duration, then on pitch change while little dependence was seen on either pressure or pitch.

For both subjects every emphasized utterance lasted longer than their neutral utterances, even without pauses for D. L. Moreover, the leftmost constituent tended to appear as more increased in the prosodic features.

4. Conclusion

Some reflections of the emphasis were peculiar to each subject and others were similar for both subjects. In the case of R. B. the emphasis on the first constituents of all his emphasized utterances were well reflected as positive changes in the all prosodic features measured and all the changes on the first constituents were more or less compensated. D.L., on the other hand, preferred to use a pause to emphasize the adjacent item and pitch became the highest in the utterance when he emphasized the second constituent, the subject of the sentence.

It was shown in Table 5 how clearly the emphases in group A, B, and C were reflected in the prosodic features according to each prosodic feature. The emphases of R. B. were most clearly reflected in pitch change, secondly in duration, then in pressure change, then in pressure, and in pitch. Although there was some difference in the rate change for prosodic features, R.B.'s emphases were thoroughly reflected in every feature. In the mean time, it is hard to retrieve some conclusive presumption from the results of D. L. without the influences of pauses as he inserted a pause without inhalation into all his emphasized utterances excluding sentence 3). Compared with the results of R. B., the small values of duration and pressure are conspicuous. Although the small value of duration must be a natural result as pause itself can be reckoned as a silent duration, the small value of maximum pressure might also be caused by the insertion of pauses. The energy

spent for pauses might have been compensated with some energy which would otherwise to have been spent for increase in pressure. The large value of pitch change, on the other hand, illustrated that D. L. depended for his emphases greatly on pitch change as R. B. did.

It seems possible to conclude where to put a pause if a speaker prefers to use it to emphasize a particular constituent from the places that D. L. used his pauses. For emphasizing the first and the last constituent, a pause would be just after the first constituent and just before the last constituent, respectively. Such a pause can cut off a continuous F_0 contour and make the preceding or following constituent isolated and prominent. For the emphasis on the subject of the Yes-No question whose grammatical construction is $S+V$, $S+V+C$, $S+V+O$, ($S+V+O+O$ or $S+V+O+C$, neither of which has been adopted as a sample sentence) a pause would appear just after the subject. In a Yes-No question of such a sentence, the collocation between the subject and the verb is less strong than the linkage between the first appearing auxiliary verb such as *Do*, *Does*, *Did*, *Have*, or *Will* or a copula such as *Is*, *Are*, or *Was* and the following subject, and is also less strong than the linkage between the verb and the following item, complement or object. The emphasis on the main verb also seems to prefer a pause just before it.

Table 6 illustrated how clearly the emphases were reflected according to constituents. A priority of emphasis can be roughly seen on the first constituent for both subjects. When the sentence consists of three constituents, R.B.'s emphases were most reflected on the first constituent and least reflected on the last constituent while no conclusive presumption can be made from the results of D. L. When there were four constituents, R.B.'s emphases were most reflected on the first item and least reflected on the second item while D. L.'s emphases were equally reflected on the first and the third item and were represented as a negative change on the last item.

Since it is uncertain how the insertion of pause influences the other prosodic features, the data of D. L., who used a pause for most of his emphasized utterances, was excluded for mentioning the possibility of compensation. In the data of R. B. there were twelve positive changes out of fifteen values (five kinds of prosodic values for three emphasized constituents) in group A, eight positive changes out of fifteen values (ditto) in group B, and seventeen positive changes out of twenty (five kinds of prosodic values for four emphasized constituents) in group C, which resulted in thirty-seven positive changes out of fifty prosodic values, i.e. 74%. Suppose it can be thought that such a positive change was more or less compensated when there was 10% or more negative change in any other constituent in the same prosodic feature measured, there were twenty-seven negative changes for the thirty-seven positive changes, i.e. 73%. It seemed that many emphases in affirmative Yes-No questions were reflected as some increase in the prosodic features dealt with in this paper and the increases were usually compensated at the same time with some prosodic decrease in other constituent(s).

From the results obtained in the analyses it seems clear that the emphasis on the first constituent tends to appear as more positive change in both value of change and the kinds of prosodic feature and that the duration of emphasized sentences always gets longer than the neutral speeches. Although a few emphases appeared as negative changes in some particular prosodic feature, the emphases in such cases could always depend on a unique F_0 contour of the item emphasized. It suggested that the direction of F_0 movement must be an

important prosodic feature besides the features dealt with in the present paper. Therefore, the reflection of emphasis and the possibility of compensation are expected to appear more clearly and increase, respectively, if a method to capture objectively the elusive pitch movement is established.

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Appendix

Table 2-1 Duration, Pitch, and Sound Pressure Level of Sentence 1-4 Uttered by Two Speakers

For duration there were six items and p (pause) to measure. No inhalation was noticed in any of the pauses. For pitch and sound pressure level the maximum values of the three items were listed. The durational values listed with braces under the title of No. x' are provisional values adjusting the duration of the whole sentence of No. x to the duration of that of No. 1. The values with * excluded the length of pause.

No.	sentence	duration (ms)			highest pitch (Hz)		pitch change (Hz)		max pressure (dB)		pressure change (dB)				
		Do	p	p remain	Do	memories remain	Do	memories remain	Do	memories remain	Do	memories remain			
1	1, 429	201	561	667	111	168	152	6	37	76	-30	-23	7	14	22
2	1, 468	363	553	552	219	78	148	144	6	78	-21	-25	15	13	13
3	1, 561	309	726	526	102	153	98	21	87	26	-24	-18	9	22	19
4	1, 515	149	508	858	188	188	173	2	13	100	-26	-22	5	16	25
4'	1, 429	141	479	809											
1	1, 704	261	661	782	225	216	219	25	19	51	-17	-17	8	15	23
2	1, 776*	571	553	652	271	207	210	120	65	49	-16	-18	28	18	22
2'	1, 704	548	530	625											
3	2, 160	465	951	744	140	266	219	8	135	71	-19	-18	28	29	24
3'	1, 704	367	750	587											
4	1, 683*	227	721	735	156	216	271	15	75	151	-15	-19	9	28	23
4'	1, 704	239	728	742											

Table 3-1 Duration, Pitch, and Sound Pressure Level of Sentence 5-8 Uttered by Two Speakers

For duration there were six items and p (pause) to measure. No inhalation was noticed in any of the pauses. For pitch and sound pressure level the maximum values of the three items were listed. The durational values listed with braces under the title of No. x' are provisional values adjusting the duration of the whole sentence of No. x to the duration of that of No. 5. The values with * excluded the length of pause.

No.	sentence	duration (ms)			highest pitch (Hz)		pitch change (Hz)		max pressure (dB)		pressure change (dB)				
		Are	p	p animals	Are	men animals	Are	men animals	Are	men animals	Are	men animals			
5	1, 301	99	197	1,005	128	175	132	17	47	59	-22	-22	6	9	27
6	1, 371	327	185	859	192	77	161	105	10	84	-11	-23	18	9	22
6'	1, 301	310	176	816											
7	1, 481	214	433	834	120	166	190	6	97	121	-21	-19	8	21	21
7'	1, 301	188	381	734											
8	1, 590	174	330	1,086	129	190	129	14	35	62	-21	-17	8	29	26
8'	1, 301	142	271	891											
5	1, 563	201	501	861	146	210	250	6	68	94	-18	-18	2	20	25
6	1, 685*	610	311	764	225	205	258	84	79	86	-20	-22	26	13	23
6'	1, 563	566	289	711											
7	1, 623	207	562	854	129	225	219	8	100	96	-22	-19	5	26	28
7'	1, 563	199	540	820											
8	1, 527*	182	489	856	122	172	280	5	55	135	-23	-19	3	21	34
8'	1, 563	186	499	873											

Table 4-1 Duration, Pitch, and Sound Pressure Level of Sentence 9-13 Uttered by Two Speakers

For duration there were eight items and p (pause) to measure. No inhalation was noticed in any of the pauses. For pitch and sound pressure level the maximum values of the four items were listed. The durational values listed with braces under the title of No. x' are provisional values adjusting the duration of the whole sentence of No. x to the duration of that of No. 9. The values with * excluded the length of pause.

	duration (ms)				highest pitch (Hz)				pitch change (Hz)				max pressure (dB)				pressure change (dB)									
	No.	sentence	Dose	p	Eddie	p	love	p	apples	Dose	Eddie	love	apples	Dose	Eddie	love	apples	Dose	Eddie	love	apples					
Englishman (R. B.)	9	1,586	207		293		212		874	106	170	130	136	7	46	9	50	-26	-24	-19	-29	10	16	19	21	
	10	1,871	488		414		202		767	205	80	77	86	127	10	7	19	-14	-24	-27	-26	22	16	14	24	
	10'	(1,586)	(414)		(352)		(172)		(652)																	
	11	1,625	193		480		198		754	144	140	76	95	21	70	4	17	-24	-19	-24	-28	11	16	16	21	
	11'	(1,586)	(188)		(470)		(194)		(739)																	
	12	1,816	178		349		495		794	105	99	146	161	7	36	69	36	-25	-16	-15	-27	8	20	27	23	
	12'	(1,586)	(155)		(304)		(431)		(691)																	
	13	1,929	356		284		371		918	93	177	168	200	8	101	4	132	-24	-19	-19	-18	25	14	31	29	
	13'	(1,586)	(293)		(233)		(304)		(753)																	
	American (D. L.)	9	1,973	348		378		492		755	175	250	183	219	19	58	15	69	-19	-22	-22	-24	18	20	16	26
		10	2,270*	832	107	344		385		709	153	136	115	107	56	28	11	4	-15	-19	-22	-25	35	14	15	25
		10'	(1,973)	(723)		(299)		(335)		(617)																
		11	2,090	505		478	190	351		756	125	231	125	133	12	119	25	22	-21	-19	-22	-24	28	23	18	29
11'		(1,973)	(477)		(451)		(331)		(714)																	
12		2,157*	269		428	163	675		785	125	141	216	250	3	17	101	84	-23	-22	-19	-29	14	20	21	24	
12'		(1,973)	(246)		(391)		(617)		(717)																	
13	2,100*	274		445		593	504	787	137	216	163	213	3	35	19	23	-18	-18	-18	-26	15	20	27	25		
13'	(1,973)	(257)		(418)		(557)		(740)																		

Table 2-2 Rates of Prosodic Changes in Emphatic Utterances of Sentence 2, 3, and 4 Compared with Neutral Utterances

(— : 30% or more decrease, — : 29-20% decrease, - : 19-10% decrease, ≡ : 9-1% decrease or 1-9% increase, = : no change, + : 10-19% increase, ++ : 20-29% increase, +++ : 30-49% increase, +++ : 50% or more increase)

	duration			highest pitch			pitch change			max pressure			pressure change		
	No.	Do	memories remain	Do	memories remain	Do	memories remain	Do	memories remain	Do	memories remain	Do	memories remain	Do	memories remain
Englishman (R. B.)	2	+	≡	-	+	+	-	+	+	+	≡	+	+	+	≡
	3	+++	+	—	≡	—	+++	—	+	+	+	+	+	+	+
	4	—	-	++	+	+	-	+	+	+	≡	+	+	+	≡
American (D. L.)	2	+	—	—	+	+	+	+	+	+	+	+	+	+	≡
	3	+++	+	—	≡	—	+	+	+	+	+	+	+	+	+
	4	≡	≡	≡	+	+	+++	+	+	+	+	+	+	+	++

Table 3-2 Rates of Prosodic Changes in Emphatic Utterances of Sentence 6, 7, and 8 Compared with Neutral Utterances

(— : 30% or more decrease, — : 29-20% decrease, - : 19-10% decrease, ≡ : 9-1% decrease or 1-9% increase, = : no change, + : 10-19% increase, ++ : 20-29% increase, +++ : 30-49% increase, +++ : 50% or more increase)

	duration			highest pitch			pitch change			max pressure			pressure change		
	No.	Are	men animals	Are	men animals	Are	men animals	Are	men animals	Are	men animals	Are	men animals		
Englishman (R. B.)	6	+	-	+	+	+	+	+	+	+	+	+	+		
	7	+	+	—	≡	+++	+	+++	+	+	+	+	+		
	8	+++	+++	-	≡	≡	≡	≡	≡	≡	≡	+	+		
American (D. L.)	6	+	—	+	+	+	+	+	+	+	+	+	+		
	7	≡	≡	≡	+	+	+	+	+	+	+	+	+		
	8	≡	≡	≡	+	+	+	+	+	+	+	+	+		

Table 4-2 Rates of Prosodic Changes in Emphatic Utterances of Sentence 10, 11, 12, and 13 Compared with Neutral Utterances

(— : 30% or more decrease, — : 29-20% decrease, - : 19-10% decrease, ≡ : 9-1% decrease or 1-9% increase, = : no change, + : 10-19% increase, ++ : 20-29% increase, +++ : 30-49% increase, ++++ : 50% or more increase)

	duration (ms)		highest pitch (Hz)		pitch change (Hz)		max pressure (dB)		pressure change (dB)	
	Does	Eddie love apples	Does	Eddie love apples	Does	Eddie love apples	Does	Eddie love apples	Does	Eddie love apples
Englishman (R. B.)	10	++	+	—	+	—	++	—	++	—
	11	+	+	—	+	—	+	—	+	—
	12	—	+	+	+	+	+	+	+	+
	13	+++	—	+	+	+	+	+	+	+
American (D. L.)	10	+	—	—	+	—	+	—	+	—
	11	+++	+	—	+	—	+	—	+	—
	12	—	+	+	—	—	—	—	—	—
	13	—	+	—	—	—	—	—	—	—

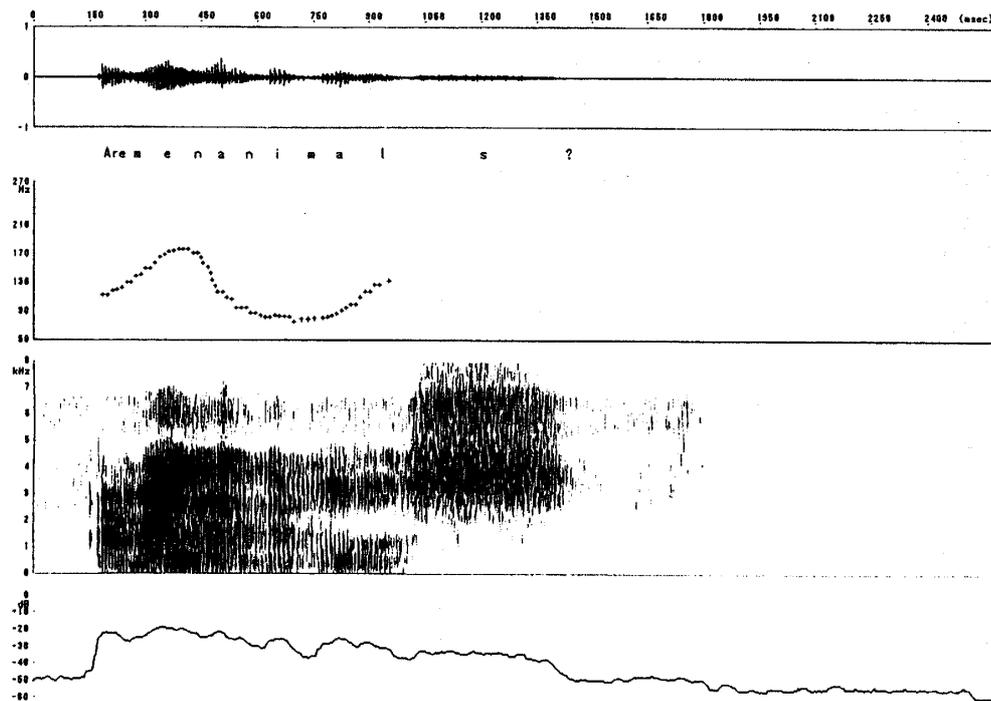


Figure 1 Speech waveform, F₀ contour, Wide-band spectrogram, and Sound pressure level of R. B.'s utterance of sentence 5)

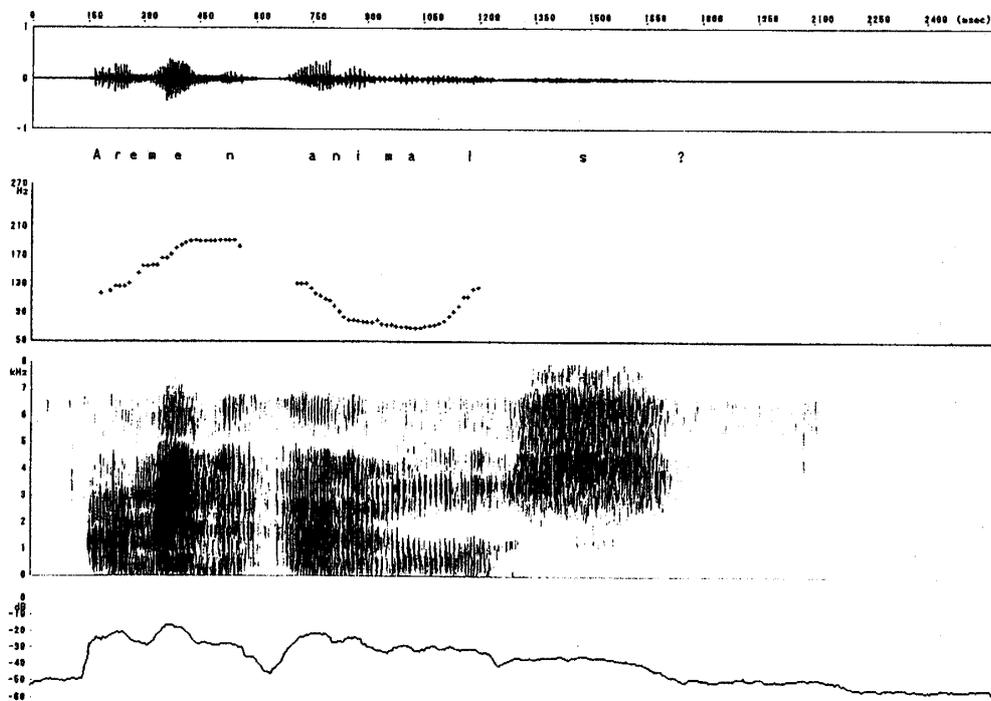


Figure 2 Speech waveform, F₀ contour, Wide-band spectrogram, and Sound pressure level of R. B.'s utterance of sentence 8)

Table 5 Integrated Reflection Degrees of Emphasis According to Prosodic Features

How clearly the emphases in group A, B, and C were reflected in the prosodic features was shown by converting the rates of changes into points. The rate of 50% or more increase (+ in Table 2-2, 3-2, 4-2) was given 5 points, 30-49% increase (+++) 4 points, 20-29% increase (++) 3 points, 10-19% increase (+) 2 points, 1-9% increase (≐) 1 point, no change (=) 0 point, 1-9% decrease (≐) -1 point, 10-19% decrease (-) -2 points, 20-29% decrease (--) -3 points, and 30% or more decrease (---) -4 points. The values in the following table are the total points reflected according to each prosodic feature.

R. B.	duration	pitch	pitch change	pressure	pressure change
	31	17	37	20	24
D. L.	duration	pitch	pitch change	pressure	pressure change
	9	11	32	3	23

Table 6 Integrated Reflection Degrees of Emphasis According to Constituents

How clearly the emphases were reflected in the prosodic features was shown by converting the rates of changes into points. The rate of 50% or more increase (+ in Table 2-2, 3-2, 4-2) was given 5 points, 30-49% increase (+++) 4 points, 20-29% increase (++) 3 points, 10-19% increase (+) 2 points, 1-9% increase (≐) 1 point, no change (=) 0 point, 1-9% decrease (≐) -1 point, 10-19% decrease (-) -2 points, 20-29% decrease (--) -3 points, and 30% or more decrease (---) -4 points. The values in the following table are the total points reflected in the prosodic features according to each constituent.

R. B.	group A		group B		group C	
	1st const.	21	1st const.	21	1st const.	23
	2nd const.	10	2nd const.	12	2nd const.	7
	3rd const.	9	3rd const.	-3	3rd const.	16
					4th const.	13
D. L.	group A		group B		group C	
	1st const.	19	1st const.	17	1st const.	12
	2nd const.	13	2nd const.	5	2nd const.	6
	3rd const.	10	3rd const.	10	3rd const.	12
					4th const.	-7