# The Stability of Distinctive Vowel Length in Thai

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## INTRODUCTION

Many languages have phonological distinctions of quantity in consonants or vowels or both. Among them, Italian is known for its word-medial intervocalic short and long consonants, while Pattani Malay (Abramson, 1987) is unusual in having word-initial prevocalic short and long consonants. Swedish, some dialects of German, and Thai have short and long vowels. Finnish has a length distinction for both consonants and vowels. Such distinctive length in segments is, of course, different from other communicatively relevant roles of timing in speech, e.g., in stress and intonation.

The obvious physical correlate of the length distinction in phonetic segments is relative duration. That is, in the simplest case the articulatory configuration is held longer for the "long" segment than for the "short" one. Limiting our attention here to vowels, we note an important observation made by Daniel Jones (1950, p. 28): "In languages where vowel length is significant it very often happens that the quality of a long vowel is not quite the same as that of the corresponding short vowel." Ilse Lehiste (1970, pp. 30–33) amplifies the point by commenting that in "quantity" languages some differences in the phonetic quality of short and long vowels can be observed, although such languages differ somewhat in the amount of correlation between length and quality. To the extent that relative duration *is* the primary differentiator of the two classes of vowels, some linguists may prefer to handle the timing difference phonologically as one of gemination rather than distinctive length. Gemination means that what I have been calling a long segment is in fact a sequence of two instances of the same speech sound. This implies rearticulation at the onset of the second occurrence of the segment. Auditory impressions and acoustic observations suggest strongly that such rearticulation is highly unlikely, especially within a single morpheme; nevertheless, whether or not such an argument is tenable phonetically is not a likely outcome of the data to be presented in this paper.[1]

The language of concern here is Standard Thai, the official language of Thailand. It is the standard variety of Central Thai, the regional dialect of Bangkok and a sizable area around it. Traditional Thai grammar posits nine short vowels and nine long counterparts, as well as various diphthongs and vowel clusters. Linguists working on the language, both Thai and foreign, generally accept this view, although some may prefer to transcribe the long vowels as geminates (Tingsabadh & Abramson, 1999).

In my own early experimental phonetic approach to Thai (Abramson, 1962, chap. 2; cf. also Abramson, 1974), I examined the vowel-length contrast in isolated vowels, word-pairs in carrier sentences, and a small sampling of running speech. The resulting acoustic data clearly supported relative duration as the major differentiator of the two

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[1]Formal linguistic criteria may make it convenient to posit gemination, even when no phonetic evidence supports this analysis. An example is the presence of a morpheme or word boundary within the long segment. See Dunn (1993) for data supporting the probability of "unitary" geminates (long consonants) in Finnish but the probability of overlapping articulatory gestures in Italian.

classes of vowels. The average ratio of long vowels to short vowels was 2.9 for isolated vowels, 2.5 for the pairs in carriers, and 2.5 for running speech. In addition, experiments on perception demonstrated that for native speakers of the language relative duration provides a sufficient auditory "cue" for this phonemic distinction. At that time, the stimuli for the listening tests were made by shortening original long vowels in minimal pairs of words to values within the ranges of their short counterparts. More recently (Abramson & Ren, 1990), computer-manipulation allowed us also to lengthen original short vowels incrementally. Work by other investigators (Sittachit, 1972; Saravari & Imai, 1983; Gandour, 1984; Gandour & Dardarananda, 1984; Gandour, Weinberg, Petty, & Dardarananda, 1987; Svastikula, 1986) confirms the role of relative duration.

## THE ROBUSTNESS OF ACOUSTIC CUES

The work being presented here is part of a larger endeavor, one that seeks to investigate the stability of acoustic cues to phonemic distinctions in a range of styles of speech. The term *acoustic cue* or just *cue* was coined by the Haskins Laboratories group in the early fifties.[2] Acoustic analysis of utterances in a language should yield certain properties that differentiate one class of phonemes from all other classes in the system; furthermore, a more detailed breakdown of each such class should reveal subcategories of such properties that serve to differentiate the phonemes within the class. Experiments may show that these properties not only separate phonemes in speech production but are also sufficient to distinguish them in perception. The latter does not automatically follow from the former, since a phonemic distinction could rest on several properties with varying amounts of power as information-bearing elements for perception. A property with such power in speech perception is called an acoustic cue. Examples are shifts upward and downward in frequency of beginnings and endings of formants (resonances of the vocal tract) for the place of articulation of stop consonants, relative frequency-heights of formants for vowels, spectral location—higher or lower in frequency—and extent of frication energy for fricatives, and, for our purposes here, the relative durations of vocalic stretches for the contrast between short and long vowels.

To this day, most of what we know about the acoustic properties of speech signals and their value as cues, as well as the underlying motor behavior controlled by various physiological mechanisms, comes from the study of short utterances carefully recorded in the laboratory. Such utterances are likely to be isolated words, short expressions, or key words embedded in a carrier sentence. For perception testing, such utterances may be manipulated on the computer along certain dimensions, although most experimental work on perception has used synthetic speech. In perceptual experiments, the listeners' choice of responses may be words or even nonsense syllables that are phonologically "legal" within the language.

In some kinds of phonetic research, for example, prosody, it has long been recognized that one must work with longer spans, usually sentences but maybe even a whole discourse. Much less has been done, however, in the study of vowels and consonants in running speech or even in other styles that are not citation forms. One

[2]For a brief summary of that early work, see Liberman (1957; reprinted with an introduction in Liberman, 1996, pp. 183–198). A good account of the evolution of the concept is to be found in Liberman and Cooper (1972).

expected characteristic of spontaneous speech is less articulatory precision than in citation forms; nevertheless, in the very same spontaneous style of speech a need, from time to time, to be very clear or emphatic may yield somewhat greater precision in the control of articulatory dynamics than in ordinary citation forms. In addition, in unrehearsed running speech, whether casual or deliberate, there is much top-down information from the phonological, morphological, syntactic, and pragmatic contexts. In the classical experiments on the cues, most of the top-down information was kept out of play through the use of isolated citation forms.[3] The work presented here is part of an effort to pursue implications in the literature (Barik, 1977; Levin, Schaffer, & Snow, 1982; Remez, Berns, Nutter, *et al.*, 1991; Laan, 1992) that acoustic differences between spontaneous and read speech are complex. The plan is to study how well phonemic distinctions, as they have been analyzed in citation-form speech in the past, are preserved phonetically in running speech. Furthermore, for the many phonemic distinctions that are no doubt well maintained, we ask whether the acoustic properties linked with the distinctions are easily derived from the cues found in traditional speech-perception research.

The foregoing matters are complicated by overlap between styles. Thus, speech read from written material includes both citation forms and the more or less fluent reading aloud of texts. (Of course, skilled actors can make read or memorized speech sound quite spontaneous.) Running speech includes both read speech and spontaneous talking. Somewhere between the last two is to be fitted the giving of a formal lecture, not from a written text but from an outline. Speakers apparently vary widely in the care with which they project bottom-up phonetic information across these styles. The phonetic precision and thus, perhaps, the perceptibility, of a word is often correlated with recent occurrence of the word in the discourse, familiarity of the topic to the listener, complexity of a task to be performed, surrounding noise level, and other such factors (Lieberman, 1963; Barik, 1977; Levin, Schaffer & Snow, 1982; Fowler & Housum, 1987; Fowler, 1988; Anderson, Bader, Bard, *et al.*, 1991; Remez *et al.*, 1991; Laan, 1992; Kohler, 1992).

My attention will be restricted here to the acoustic examination of the robustness of relative duration as a differentiator of phonemically short and long vowels in Thai. Inasmuch as vowels are notoriously vulnerable to expansion and compression in time as speakers vary their rates of articulation, their speaking styles, their focus on different parts of the discourse, the extent to which a vowel-length distinction is maintained through relative duration alone ought surely to be, in its simplicity, an excellent starting point for my investigation of the robustness of acoustic cues. Other factors, such as formant patterns, that might also serve as cues, even if secondary ones, to a vowel-length distinction (e.g., Straka, 1959; Hadding-Koch & Abramson, 1964; Bennett, 1968; Abramson & Ren, 1990) will not be treated here. Words embedded in short carrier sentences, short expressions, and spontaneous casual conversation will be examined. Although the data should have implications for perception, experiments testing perceptual hypotheses derived from the findings are planned for a sequel to the present study. These hypotheses could include the relevance of other phonetic characteristics in addition to duration.

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[3]An apparent exception is the set of phonological constraints on syllable types within the language. Since one cannot utter a syllable without invoking such rules, we might argue that we are dealing here for all practical purposes with bottom-up information only.

## PROCEDURE

Eight pairs of Thai words, each pair minimally distinguished by vowel length, were recorded in semantically appropriate carrier sentences by four educated native speakers of Standard Thai. The words and a sampling of the sentences are shown in Table 1.[4] The sentences were recorded in a random order. For the first reading, the speakers were asked to use a normal, comfortable rate. For the second reading, they were asked to read faster. Each list of sentences was recorded twice by each speaker. Although in such a procedure the speaking rates were likely to differ widely from speaker to speaker, it was felt that self-determination of normal and fast rates would make for more natural productions.

Table 1. *Minimal Pairs of Words in Sentences*

Words

| | | | |
|---|---|---|---|
| tìp | 'to sip' | tȉp | 'to flirt' |
| hèt | 'mushroom' | hèt | 'cause' |
| tàk | 'to dip up' | tàk | 'to dry' |
| cam | 'to remember' | cam | 'to sneeze' |
| khǎj | 'to unlock' | khǎj | 'to sell' |
| khùt | 'to dig' | khùt | 'to scrape' |
| thun | 'fund' | thun | 'to carry on the head' |
| sòt | 'fresh' | sòt | 'unmarried' |

Sample of Sentences

| | |
|---|---|
| phájajam hǎ hèt hâj khun | 'I'm trying to find mushrooms for you.' |
| phájajam hǎ hè t hâj khun | 'I'm trying to find reasons for you.' |
| jà khùt mâk kn paj | 'Don't dig too much.' |
| jà khù t mâk kn paj | 'Don't scrape too much.' |
| mâj sâp sòt ŕ plàw | 'I don't know whether it's fresh.' |
| mâj sâp sò t ŕ plàw | 'I don't know whether he's single.' |

To obtain enough unrehearsed conversational speech, I found four members of the staff of Chulalongkorn University, two women and two men, who knew each other well, were quite used to microphones, and did not mind chatting informally about things of interest to them. Two at a time, a man and a woman, sat in a recording booth and talked to each other for ten to fifteen minutes about such topics as events on campus, plans for projects, and vacations. Their speech seemed very natural, varying widely in tempo, emphasis, and clarity. Some of it, not surprisingly, was unusable because of overlapping utterances, laughter, and other distortions.

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[4]For seven out of the eight pairs, only words with mid and low tones were used, because they were meant originally for perceptual experiments in which the vowels were to be lengthened or shortened (Abramson & Ren, 1990). These tones are least susceptible to distortion in such an operation.

With the help of a Thai colleague, one of my four speakers, I went through the recorded conversations and wrote down a number of words and short expressions uttered by each person. Then, one by one, I had each person read his or her excerpts into a tape recorder. Although this material included phrases and short sentences, it is probably best viewed as a set of citation forms.

Unfortunately, the literature does not reveal a universally accepted criterion for the measurement of vowel duration in spectrograms or waveforms. One common practice is to measure only that span of the vocalic formant pattern that is voiced, i.e., excited by glottal pulsing. Such a definition makes a partly or wholly unvoiced vowel impossible. Thus, for example, there would be no vowels in whispered speech! Others, rejecting that definition, measure the time during which the supraglottal vocal tract appears to maintain a relatively open configuration, one without local constriction or closure of the kind that yields consonants, no matter what the source of acoustic excitation is. Thus, working with the latter articulatory bias, I have measured every vowel from the release of the prevocalic consonant to the end of the formant pattern. If the syllable ends in a consonant, the sudden ending of the formants, perhaps with a visible upward or downward transition of one or more of the formants, signals the moment of closure. When necessary, help can be had by comparing the spectrogram with a waveform of the utterance.

In Figure 1 we see two Thai words taken from their carrier sentences. Both begin with a voiceless aspirated dorso-velar stop. The major difference between this and its voiceless *unaspirated* counterpart is that the latter would show voicing onset immediately after the release instead of the turbulence seen in the spectrograms and waveforms of Figure 1 (Abramson, 1989).

Thus, for the examples in the figure, as well as for voiced and voiceless unaspirated initials, the vowel onset is taken to be the release of the initial consonant. In the figure the second formant in each word moves upward for the final alveolar closure. The rectangles under the spectrograms show the vocalic spans, which include the aspirated voicing lags determined by voice onset time (VOT) (Lisker & Abramson, 1964). As a statistical test of the validity of this approach, I have measured the VOTs of all the aspirated voiceless stops of the four speakers who recorded the minimal pairs of words in the carrier sentences. I limited the test to the normal speech rate. This balanced set of words with short and long vowels yielded 24 tokens of each length. One might argue that my criterion for determining the duration of a vowel would be undermined by a finding of significantly larger VOT values for short vowels, since this would make the two length categories less different. In fact, the opposite tends to be true. The short vowels had a mean VOT of 59 ms, while the long vowels had a mean VOT of 66 ms, with considerable overlap of the standard deviations. A paired *t*-test showed the difference to be only marginally significant ($t(23) = -1.99$, $p < 0.06$).

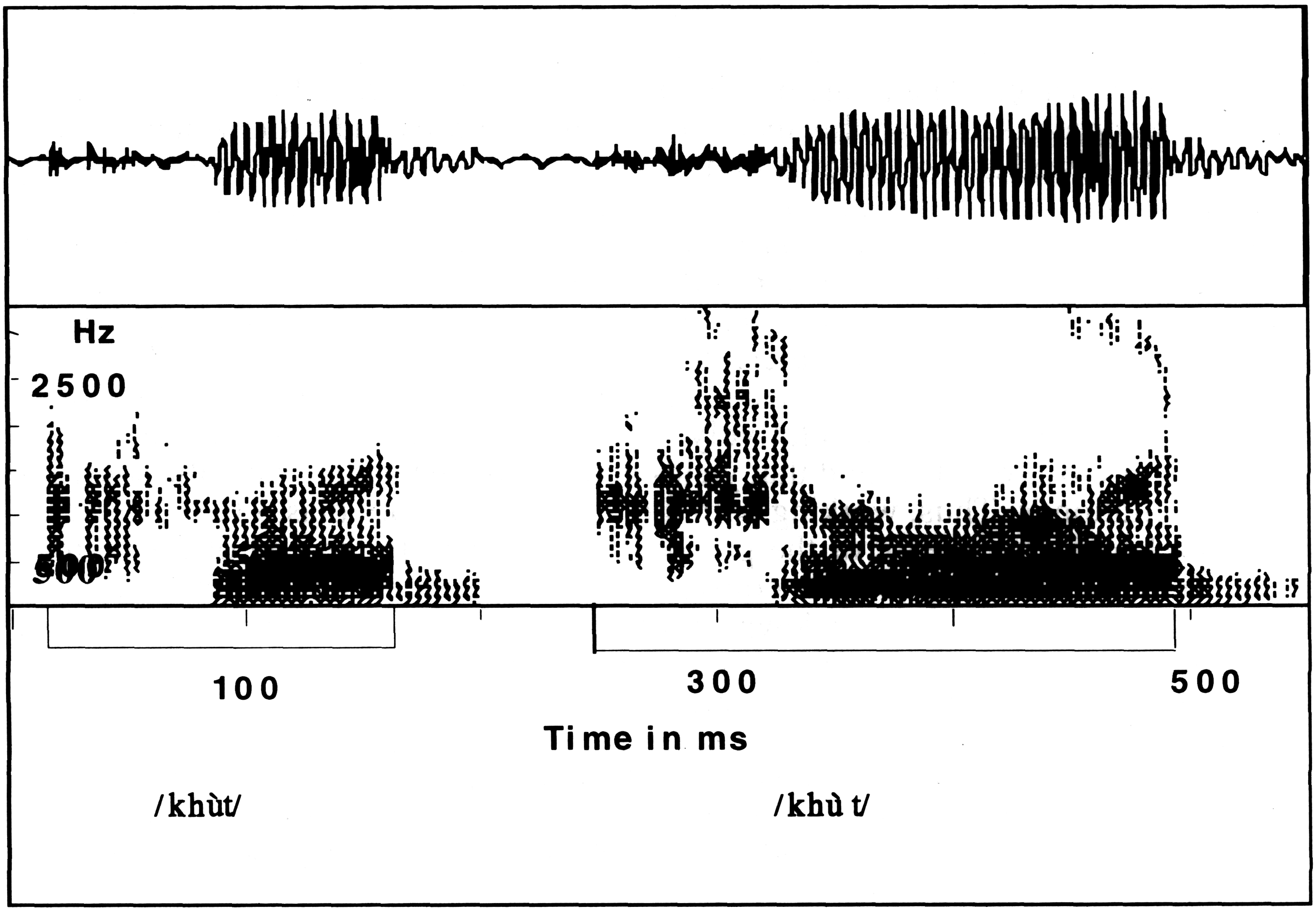


Figure 1. A minimal pair of words cut from their carrier sentences. Waveforms above and spectrograms below with the vowel durations, including aspiration, underlined.

A special problem arises in the handling of diphthongs. In a diphthong we have a gliding articulatory movement to or from a vowel target. If the vocal-tract shape of the target is held for a bit, it will be reflected in essentially steady-state formants. Only when such steady states are available do I measure the duration of the target vowel of a diphthong. Many such words with movement throughout the vocalic portion had to be left unmeasured in the running speech; any estimate of a segmentation point was simply too unreliable to inspire confidence.[5] Indeed, this may be seen as an example of the caution that is needed in undertaking the task of chopping a speech signal into spans that are said to correspond to phonetic segments.

## RESULTS

The data for the eight minimal pairs of short and long vowels in words in carrier sentences are given graphically in Figure 2. The means and standard deviations of the measurements are given for both the normal ("slow") and fast rates of speech. The

[5]Of course, with an unconventional phonological treatment of the diphthongs as "vowels of changing color," resulting in the positing of a larger inventory of vowels, one would simply measure all the short and long diphthongs without worrying about internal segmentation.

ratios of long to short vowels are 1.8 for the slow rate and 1.5 for the fast rate. The data were put through an analysis of variance. Rate as a factor was significant, $F\ (1,3) = 28.5$, $p < 0.02$. That is, the fast short and long vowels were both significantly shorter than their slow counterparts. Vowel length is also significant, $F\ (1,3) = 568.7$, $p < 0.001$. The interaction of rate and length is significant, $F\ (1,3) = 49.9$, $p < 0.006$. The identity of a word in the set of 16 words was significant, $F\ (7,21) = 45.4$, $p < 0.001$, but not the identity of a particular token of a word, $F\ (1,3) = 0.07$, $p = 0.8$, n.s. There is also a significant interaction between word and length, $F\ (7,21) = 3.6$, $p < 0.02$.

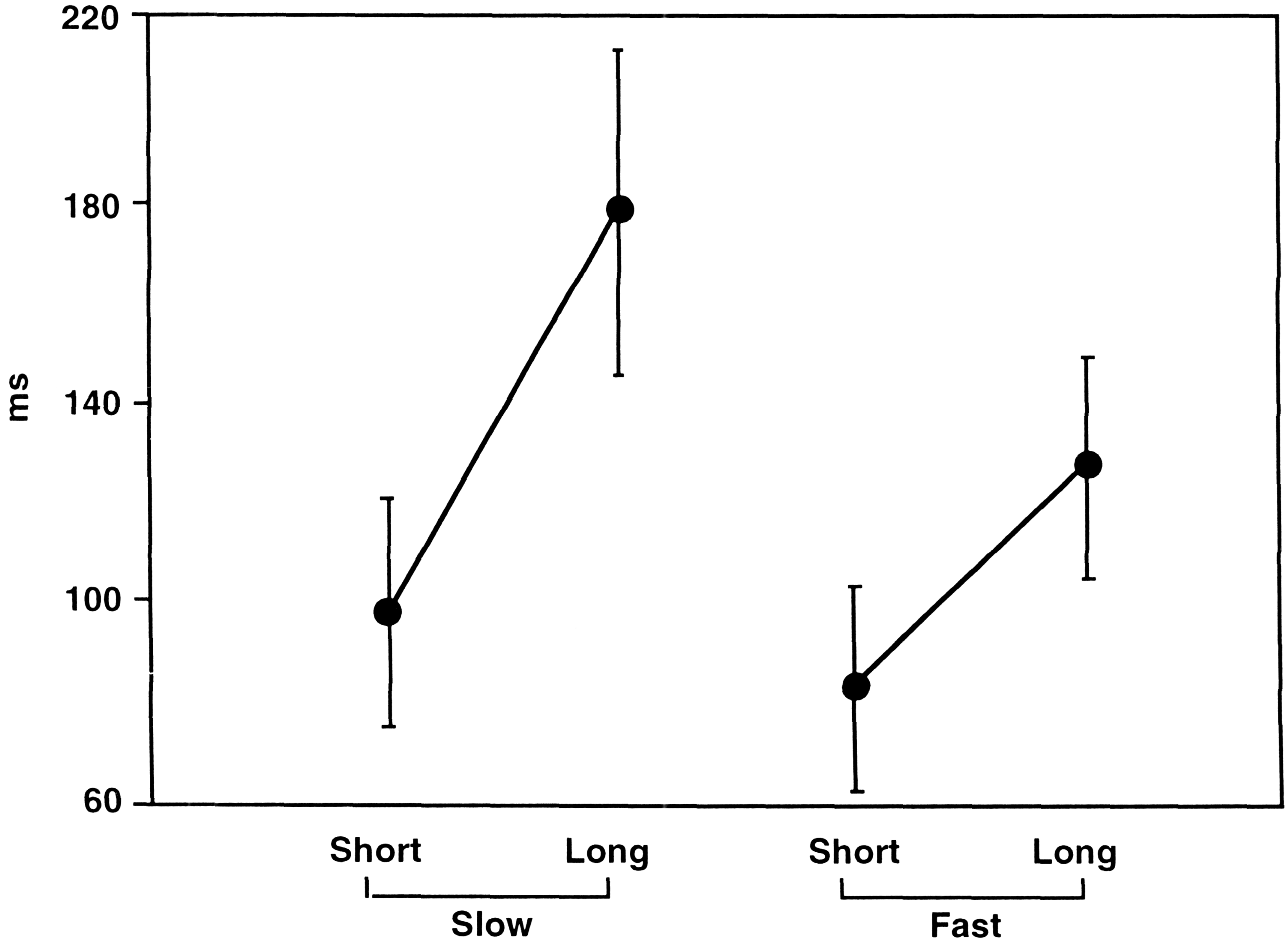


Figure 2. Means (dots) and standard deviations (vertical bars) of the durations of eight minimal pairs of long and short Thai vowels uttered in carrier sentences at two rates, normal ("slow") and fast by four speakers. N = 64 for each point.

Table 2. *Means and Standard Deviations of Vowel Durations, and Significance Levels for the Words and Phrases Read by the Four Speakers: Unpaired* t*-Tests*

| | Number | | Short | | Long | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Spkr | Short | Long | M | SD | M | SD | *df* | *t* | *p* |
| TL | 27 | 23 | 101 | 41.8 | 222 | 52.1 | 48 | -9.2 | < .001 |
| PM | 9 | 18 | 111 | 45.8 | 233 | 108.0 | 25 | -3,2 | < .004 |
| SA | 11 | 11 | 108 | 44.2 | 205 | 66.6 | 20 | -4.1 | < .001 |
| ST | 35 | 15 | 98 | 36.3 | 224 | 97.1 | 48 | -6.7 | < .001 |

The means and standard deviations of the vowel durations measured in the conversational excerpts that were separately recorded by all four speakers are given in Figure 3. The ratio of long to short vowels is 2.2. The results were shown by unpaired *t*-tests to be highly significant for each of the speakers, as seen in Table 2.

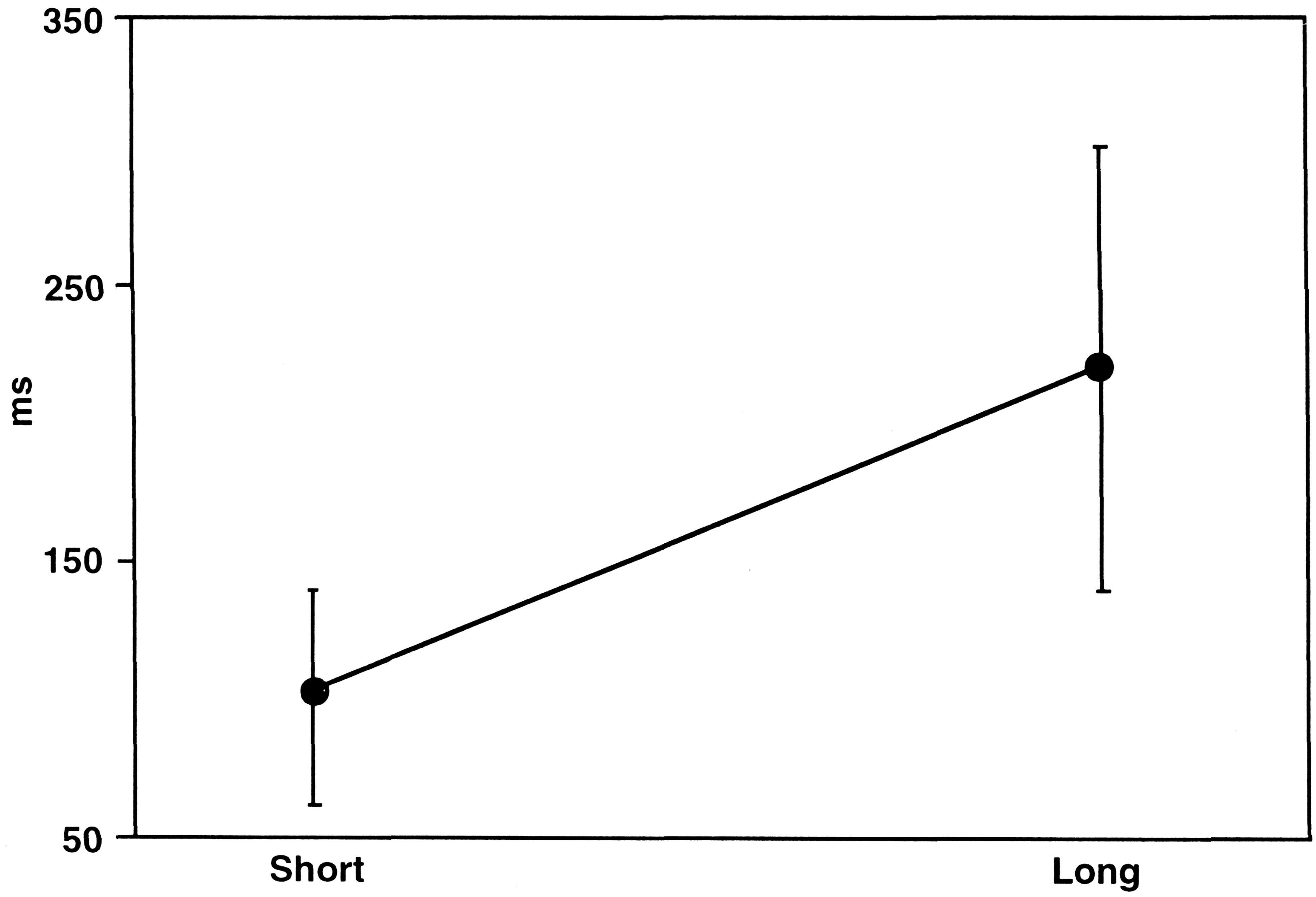


Figure 3. Means and standard deviations of 82 short and 67 long vowels in words and phrases read by four speakers.

Table 3. *Vowel-Duration Means, Standard Deviations, and Significance Levels for the Running Speech of the Four Speakers: Unpaired* t-*Tests*

| | Number | | Short | | Long | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Spkr | Short | Long | M | SD | M | SD | *df* | *t* | *p* |
| TL | 146 | 133 | 110 | 49.4 | 213 | 92.7 | 277 | -11.8 | < .001 |
| PM | 55 | 46 | 96 | 35.0 | 206 | 64.1 | 99 | -11.0 | < .001 |
| SA | 81 | 77 | 91 | 27.8 | 192 | 60.6 | 156 | -13.5 | < .001 |
| ST | 156 | 125 | 113 | 38.9 | 219 | 77.0 | 279 | -15.1 | < .001 |

As for the running speech, the means and standard deviations of the vowel durations are given for all four speakers in Figure 4. The ratio of long to short vowels for the data in the figure is 2.1. The results were shown by unpaired *t*-tests to be highly significant for each of the speakers, as can be seen in Table 3.

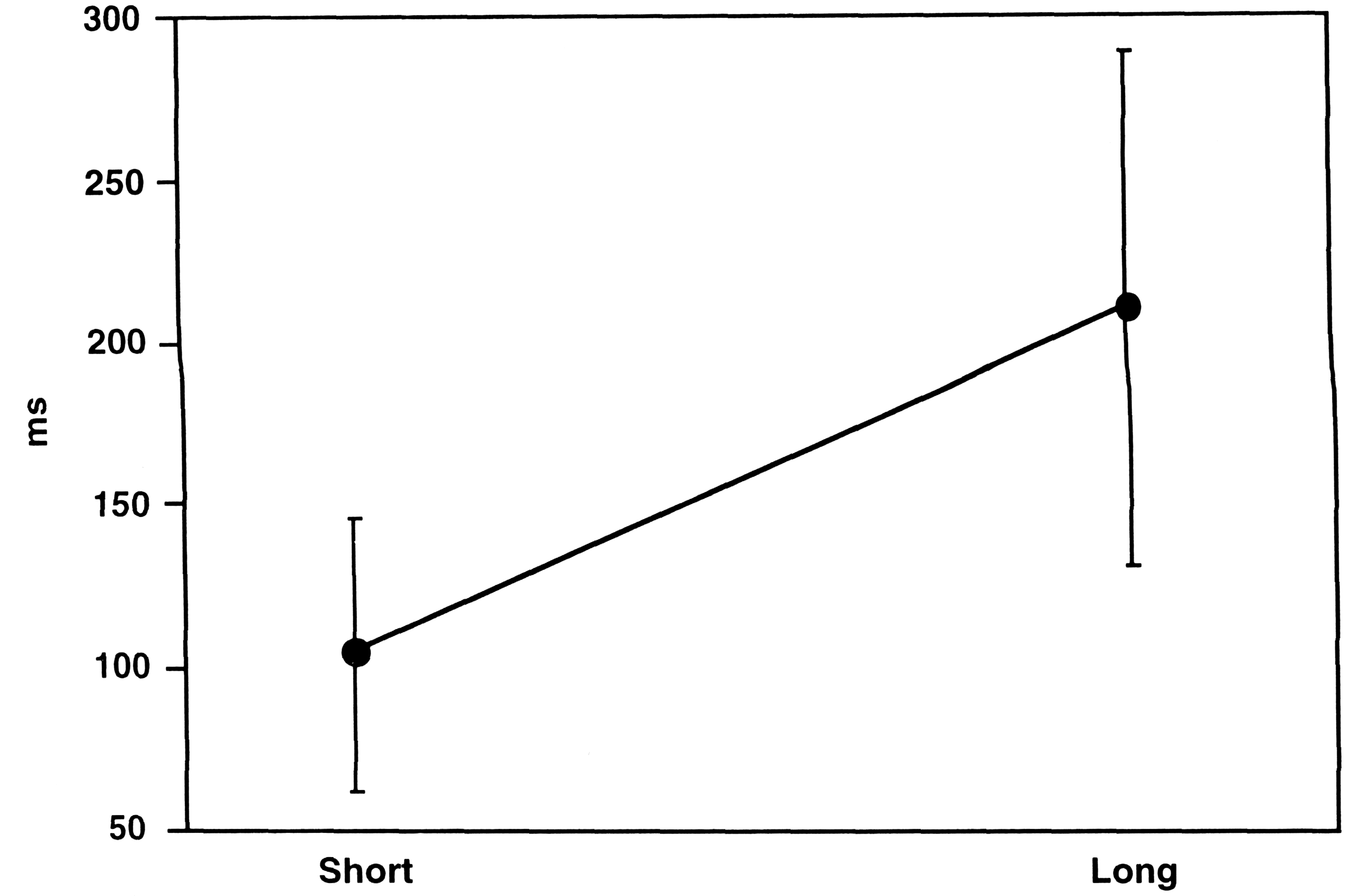


Figure 4. Means and standard deviations of 438 short and 381 long vowels in the running speech of all four speakers

It is necessary now to digress and state that these data have been taken only from vowels that I could identify with great confidence as short or long. I hasten to add that what should seem obvious is not so simple a matter in Thai running speech. That is, we cannot always decide on the basis of its citation form or dictionary entry which length the vowel of a morpheme has in an utterance. There are rule-governed shifts from long vowel to short in non-final morphemes in compound nouns and reduplicated adverbials (Sutadarat, 1978, pp. 70–71). In addition, in very casual speech there is a tendency to have weak stress with shortening of lexical long vowels in other constructions and in certain syntactic classes of words that are unstressed, such as particles, negatives, and some adverbs (Sutadarat, 1976, pp. 149–150). Contrariwise, some of the latter that are lexically short may become long under emphatic stress. Where such processes are evident, I have not hesitated to assign the resulting vowels to the deviant category. For all others, I have assigned them to the category found in the lexical entry or citation form, even when a "long" vowel seemed surprisingly short for its context, or a "short" vowel surprisingly long. Such a criterion, it seems to me, must be adopted if one is to run a fair test of the stability of the length distinction. One good outcome of this study would be an attempt by phoneticians and phonologists, especially those who are native speakers of Thai, to formulate stringent criteria for handling the matter. In the meantime, I believe that the dubious cases are few enough not to affect the results seriously.

The ratio of T.L.'s long to short vowels in running speech, i.e., for her data in Figure 4, is 1.9. Since she is the only speaker whose vowels have been measured under all three conditions, it may be of some interest to compare her data between conditions. This was done by means of unpaired *t*-tests.

First, let us compare the read excerpts and the slow and fast minimal pairs in sentences. In the comparison of the read material with the slow pairs, the difference is not significant for the short vowels ($t\,(41) = -0.3, p = 0.7$, n. s.), but it is significant for the long vowels ($t\,(37) = 2.6, p < 0.02$). For the fast pairs, again the difference between the two sets of short vowels is not significant ($t\,(40) = 1.3, p = 0.21$, n.s.), while for the long vowels it is highly significant ($t\,(37) = 6.3, p < 0.001$).

Comparisons of the excerpts and the minimal pairs with running speech yield mixed results. There is no significant difference between the excerpts and running speech either for the short vowels ($t\,(171) = -0.9, p = 0.37$, n.s.) or for the long vowels ($t\,(154) = 0.5, p = 0.65$, n.s.). As for the slow minimal pairs and running speech, there is likewise no significant difference either for the short vowels ($t\,(160) = -0.4, p = 0.68$, n.s.) or the long vowels ($t\,(147) = -1.2, p = 0.24$, n.s.). Turning to the fast pairs and running speech, however, we find that the differences are barely significant for the short vowels ($t\,(160) = -2.0, p < 0.06$) and quite significant for the long vowels ($t\,(147) = -3.3, p < 0.002$).

## DISCUSSION AND CONCLUSION

By and large, in answer to the question raised at the beginning of this paper, we can say that the quantity distinction between short and long vowel phonemes in Thai is certainly maintained in a variety of speaking conditions. This is true despite the fact that, except for the slow pairs in Figure 2, the standard deviations for the short and long vowels overlap in the pooled data of Figures 2, 3, and 4, giving us to understand that there is a fair amount of overlap between the ranges of values for the two categories in all three speech conditions.[6] On the face of it, there would seem to be a problem in that one could not simply pick a datum at random from the region of overlap in the range of durations, even for a single speaker, and decide with great confidence whether it was from a short or long vowel. We can turn to the best controlled of the conditions, the minimal pairs in carrier sentences, to find at least part of the answer. The analysis of variance shows the choice of word in the set of 16 to be a highly significant factor; it also shows a significant interaction between the factors of word and vowel length. As can be seen in Table 1, there is considerable variability in the phonemic makeup of the eight pairs of words. That is, not only are we dealing with eight different vowels but also quite a variety of consonantal contexts and two tones.[7] Fitting well with this finding is the failure to show the choice of tokens of the words to be significant; thus, utterances of the same word, having, of course, exactly the same phonological composition, do not differ significantly from each other in vowel duration.[8] Of course, the variability in these factors was greater in the excerpts

[6]Inspection of Tables 2 and 3, however, suggests that individuals vary somewhat in the amount of overlap even in such a variety of contexts.

[7]See f.n. 4. Although only the mid, low, and rising tones occur here, all five tones appear quite freely in the excerpts and the running speech.

[8]There were, it is true, only two tokens of each word for each rate for every speaker. Had there been more tokens with the same statistical result, there would be even more support for the internal solidarity of the word.

read from a script and even more so in the sample of running speech, although there was no significant difference between the latter two sets of data.

In an attempt to cope with some of these factors, I thought that focusing on single vowel pairs distinguished by length might help. For only one vowel pair, /a a:/, were there sufficient data in the conversation of two speakers for statistical treatment with an unpaired *t*-test. For SA, with 39 instances of the short vowel /a/ and 33 of the long /a:/, the difference was highly significant: $t\,(70) = -10.5, p < 0.001$. For TL, with 62 instances of the short vowel and 60 of the long one, the difference was also highly significant: $t\,(120) = -7.3, p < 0.001$. Thus, there is agreement with the findings for the whole set. At the same time, it must be admitted that looking at a single vowel pair yielded very little reduction of overlap. This is perhaps not surprising when we consider that the items included both CV and CVC syllables; furthermore, all other contextual variables were not under control.

In relaxed running speech other variables must play a role in how carefully separated short and long vowels are. These include tempo, emphasis, familiarity of the subject matter, first or later occurrence of an important word, sentence intonation, position in the sentence, ambient noise, and perhaps other factors, such as variation in vowel quality correlated with length.

Presumably speakers of Thai, as well as other languages with phonological distinctions in quantity, learn to take these factors into account while processing the relative durations of short and long vowels. That is, as with other kinds of phonemic contrast, the mental grammar may embrace several phonetic correlates of the length distinction, even if one of them, relative duration, is more powerful than the others. The work of Svastikula (1986) certainly supports this contention for the factor of rate.

A question of method arises, namely, whether one could have more control over these variables while still eliciting truly spontaneous speech. Some approaches have been tried that yield better comparability between speakers (e.g., Terken, 1984; Anderson *et al.*, 1991; Swerts & Collier, 1992). Speakers are told, one by one, to do the same verbal task, such as describing a graphic network or reading a map. Such a task makes it highly likely that all the speakers used will produce linguistically similar utterances that are natural responses to the prescribed situation, even though their semantic scope and, probably, their syntactic range are somewhat constrained. My choice of relaxed, lively conversations between people well known to each other on topics of their own choosing bought virtually perfect spontaneity at the price of little or no control over contextual variables. As an extension of this project, it will certainly be desirable to consider eliciting monologues built on carefully constructed situations or tasks.

I plan, following a common practice in experimental phonetics, to seek perceptual validation of this general finding for speech production. The first step will be to present unaltered words from the present samples of running speech to native speakers of Thai for identification. Of course, it will be necessary to choose words that have counterparts of the opposite length. The words chosen will not be cut from the immediately surrounding context, because this could unreasonably mislead the listener. Instead, I will low-pass filter the context to remove syntactic and semantic redundancy, while at the same time keeping the intonational line and tonal features of the context and a speechlike quality. That is, the contexts will be unintelligible while still sounding speechlike. The resulting stimuli will be used in identification tests to determine whether the phonemic contrast is preserved not only in production, as it would seem from the results of the present study, but also in perception. Next, if the distinction *is* perceptually robust, the acoustic structure of the words will be manipulated to see how well the cues in casual speech match those in citation forms. Work by Abramson and Ren (1990) revealed that spectral differences between short and long vowels in minimal pairs of words embedded in carrier sentences have no more than a small effect on the efficacy of relative duration as a cue. Perhaps the role of this and other features is, under certain conditions, sometimes larger in running speech. The undertaking will be begun with changes in duration of the vowels of the words taken from passages of connected speech. The incrementally lengthened original short vowels and incrementally shortened original long vowels will be used as stimuli in perception tests. The next obvious step would seem to be the introduction of incremental spectral differences by raising and lowering formant frequencies.

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