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University of Oran
Faculty of Arts and Foreign Languages
Department of English

Research on Rhythm (Stress-Timing and Isochrony) A Comparative Study of Oran Teachers' and British Native Speakers' Realisations

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By: Souhaila SENOUCI BEREKSI BELKHEIR

Supervisor:
Prof. M. DEKKAK

President of Jury: Prof. A.BOUAMRANE
Member of Jury: Dr A BAHOUS
Member of Jury: Mr R. BENALI

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Abstract

The present research aims to assess the state of rhythm of English in its dual manifestation, stress-timing and isochrony, in some Oran schools. The selected variety is British English as it is the one taught in our schools and colleges. We hope to achieve this objective by weighting the oral performances of a representative sample of thirty Oran teachers of English, and more specifically, in their realisations of twenty-five utterances and a rhyme, against those of British native speakers'.

The first chapter sets the theoretical background of rhythm and its relationship to stress-timing on the one hand and to isochrony on the other. A few words are said about acoustics, or at least those of its aspects which we make use of in the present research.

The second chapter presents the two components of the corpus, the four British and the thirty local informants, the measuring tools such as WASP and Metronome, and the various calculations and statistical operations that make up the bulk of this research.

The third chapter makes use of ear perception as a way of rating and ranking, on a scale from four to one, the non native informants and detecting in their realisations the presence or absence of isochronous stress-timing in selected utterances as well as in a traditional rhyme.

The fourth chapter presents and analyses the findings of three instrumental operations related to stress-timing in the twenty-five utterances of the corpus.

The fifth chapter presents and analyses the findings of four instrumental operations related to isochrony in a traditional British Rhyme, '*This is the house that Jack built'*.

Tentative conclusions are drawn and a few suggestions are offered.

The results concern sometimes the groups, and they give a picture of the state of rhythm in this part of the world, and sometimes they concern the local performers as individuals.

A calculations booklet accompanies the present research and is included in the Appendix. There is also a CD with all the recordings, and the appropriate software applications.

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Abbreviations Used

Bpm:	Beat per measure in music, roughly a minute in speech.
EPA:	Evaluation through Perceptual Analysis.
EVAL:	Evaluators used in EPA.
FAT:	Female Algerian Teacher(s) of English from the Wilaya of Oran.
MAT:	Male Algerian Teacher(s) of English from the Wilaya of Oran.
NAS:	Native Speakers of English, whose means set the norms.
Part #:	Number of the Part of the Rhyme. The Rhyme is divided into five parts.
RU:	Rhythm Unit, working definition of a stressed syllable. The corpus includes utterances containing from one RU to five RUs.
#RU_#Syl:	Number of Rhythm Units and total number of syllables. Thus a 3RU_5Syl utterance would indicate a sentence of 5 syllables 3 of which are Rhythm Units, i.e. stressed syllables.
SD:	Standard Deviation.
SSH:	Stress-timed Syllable-timed Hypothesis.
Syl:	Syllables of any kind, be they stressed or unstressed.
#_#	3_5 would mean the same as 3RU_5Syl above

Working Definitions

Coda:	A coda refers to the consonant sound or sounds of a syllable which may follow the syllabic nucleus, or vowel. Example: the /p/ of /cup/.
Deviation:	Difference between the norms set by the means of the realisations of the native speakers, and the corresponding individual or group realisations by local teachers.
Function word:	Member of a closed class of words in grammar (e.g. articles, pronouns, conjunctions, auxiliaries, prepositions, modal verbs.). Have more than one phonological realisation (e.g. can). Unstressed in all our corpus.
Group:	Concerns the different informants as a group. It might be the British native speakers as a group, or the female teachers as a group, or the male teachers as a group.
Increment Rate:	The percentage by which a varying quantity increases or decreases between two of its stages.
Individual performer:	Concerns one individual informant, may be an individual British native speaker, or a female or a male local teacher from the Wilaya of Oran.
Intonation contour :	The same utterance can have contrastive values if different contours are used (mid-fall, high-fall, rise-fall, rise-fall, etc.) suggesting different attitudes on the part of the speaker while keeping the same denotational meaning. These contours are obtained through pitch variations. In the present research, the targeted contour is 'neutral' (non contrastive) and

	'normal' suggesting no specific attitude (surprise, anger, protest, etc.).
Isochrony:	Regular recurrence of stressed syllables at more or less equal intervals.
Mean Duration:	The individual durations[1] of a specific group of informants are added and divided by 4 for the NAS, 25 for the FAT, and 5 for the MAT.
Lexical word:	Member of an open class of words: new words are being added regularly. The class includes nouns, adjectives, full verbs, adverbs, numerals, interjections.
Mora:	Minimum unit of metrical time equivalent to a short syllable in e.g. Japanese.
Moving tune:	The sentence stress as opposed to the static word stress. In our utterances, it always falls on a lexical word.
Neutral intonation:	Unmarked, not contrastive intonation. It typically falls on the stressed syllable of the last lexical word of an utterance.
Norm:	The norm is the mean of the native speakers' realisations.
Rate of delivery:	The speed at which an individual informant realises the corpus.
Rejoinder:	Any of the 25 sentences of the five sets of the corpus, because they are all authentic answers to questions or statements (here called initiators).
Rhyme:	Unless explained otherwise, it refers to the traditional British rhyme *This is the house that Jack built.*
Rhythm unit or RU:	The stressed syllable in a sense group. In the corpus under study, the number of RUs varies from one in Set 1 to five in Set 5.
Rhythm:	A term used in phonology to refer to the perceived regularity of prominent units in speech. These regularities may be stated in terms of patterns of stressed versus unstressed syllables, syllable length (long versus short) or pitch (high versus low). The object of this research is to study two of its aspects: stress-timing and isochrony.
Sense group:	Also known as breath group. Any of the 25 utterances of the corpus under study when they are preceded by a pause and followed by a pause.
Set:	There are five such sets. The first set contains 4 rejoinders of 1 RU; the second set contains 6 rejoinders of 2 RUs; the third set contains 6 rejoinders of 3 RUs; the fourth set contains 8 rejoinders of 4 RUs; and the fifth and final set contains a single sentence created for the occasion.
Standard Deviation:	The standard deviation is a statistical operation that tells how the informants are tightly clustered or widely spread apart around the mean in a set of data. If SD is small, close to zero, the informants form a homogeneous group; if SD is large, farther from zero, the informants form a heterogeneous group.
Utterance:	One of the twenty five sentences under study.

[1] Throughout this document, decimal numbers are separated by a comma instead of a dot: e.g. 0,564 second instead of 0,564 second. This is for the sake of convenience, as it is the form accepted by the version of Microsoft Office Excel we use.

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General Introduction

It is widely accepted that the reason some learners of English continue to sound foreign and remain unintelligible has as much to do with the supra-segmental features of stress, rhythm, intonation, as it has with the segmental consonant and vowel features, on which attention has traditionally been concentrated.

The present research aims at studying the widely neglected aspect of rhythm in its dual manifestation of stress-timing and isochrony in Oran schools. Stress-timing is to be studied through the informants' realisations of twenty-five utterances *(See Appendix 2)*, while isochrony is to be assessed through the informants' realisations of the rhyme '*This is the house that Jack built' (See Appendix 4).*

Study of Stress-Timing

Our informants' realisations are measured through three of their essential elements: duration, pitch and amplitude which combine to add meaning to an utterance.

Duration makes the stressed syllables sound longer than the unstressed syllables, as for example the length of the second syllable in the word [ɪmpotənt] where /po/ (or /pə/ in some transcriptions) is unstressed, and therefore shorter, in opposition to the /pɔ/ of [ɪmpɔ:tənt] which is longer because it carries the stress.

Pitch, or fundamental frequency, its acoustic counterpart, can be measured on a scale from high to low from an auditory point of view. It is high when the signal has a short repetition period and a high repetition frequency, and it is low when the signal has a long repetition period and a low repetition frequency. It is closely connected to intonation and its variations give meaningful communicative signals in terms of feelings, emotions, attitudes, etc. For example, it distinguishes /John/ as a question from /John/ as a statement

The point is made clear in the figure below.

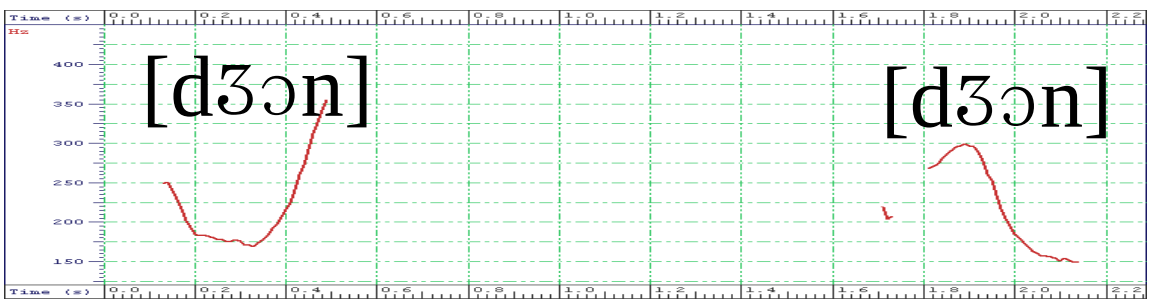


Fig 1: Pitch variations

Amplitude represents the air pressure exerted by the speaker. It is perceived as strength and loudness by the listener. It makes stressed syllables sound stronger and louder than unstressed syllables. It combines with pitch variations to indicate attitude, such as contrast in the case of /JOHN lives in London/ (and not Mary, for example).

The point is made clear through the following WASP diagram.

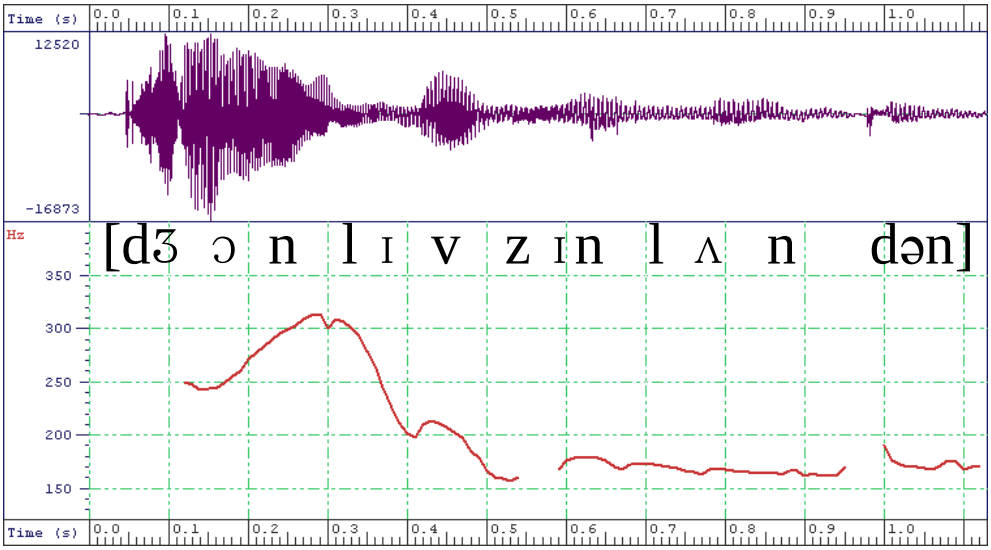


Fig 2. Amplitude and pitch to express contrast

The air pressure exerted by the speaker to pronounce the word 'John', indicated by the thick smudge above, is perceived as loudness by the listener, while the curve indicates the high-fall contour of the pitch by about 150 Hz, from just over 300 to just over 150.

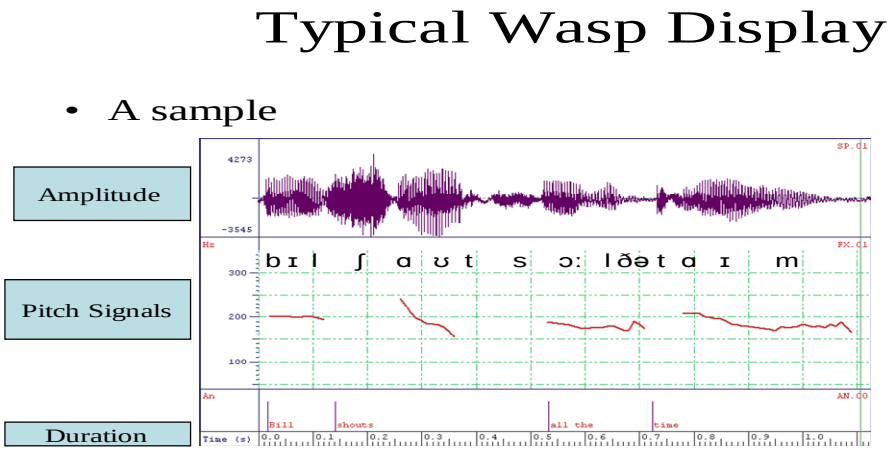


Fig. 3 Amplitude, pitch and timing of an annotated utterance

As the name implies, stress-timing is based on timing or duration of the various realisations. One aspect of our objective in this research involves the comparison of the duration of the Algerian informant's performances and see the extent to which timing increases when the number of stressed and / or unstressed syllables increases. When and if time alone does not yield telling results, we then refer to other features such as amplitude and / or pitch.

Study of Isochrony

Isochrony, from Greek *iso* meaning 'equal' and *chrono* meaning 'time', refers to the rhythmic characteristic of a language. Rhythm is said to be isochronous if stressed syllables fall at approximately regular intervals.

Many researchers (Classe, A. (1939), O'Connor, J. D. (1968), Lehiste, I. (1977), Roach, P. (1982), Dauer, R. M. (1983), Couper-Kuhlen, E. (1993), Cauldwell, R. T. (2000) among others) consider isochrony a matter of perceptual reality. In their overwhelming majority, they consider that isochrony is subjective. It is something felt by the listener rather than a physical fact that can be measured by scientific instruments.

We will compare duration, down to the thousandth of a second, and tempo, in beats per minute of a musical metronome, of Algerian teachers with that of the native speakers in the reading of a well-known British rhyme "*This is the house that Jack built*". Duration is the length of time involved in the articulation of a sound, a syllable or an utterance. It is measured in units of time, in the present case, in milliseconds. Tempo on the other hand refers to the speed of speaking or rate of delivery of individual speakers. It is measured in bpm, or beats per measure. As indicated by David Crystal (1991), this means that a speaker with a quick rate of delivery or tempo will take less time to produce the same utterance than a speaker with a slower rate of delivery.

Since the human ear cannot perceive minute differences going down to the thousandth of a second, a musical metronome (*see Appendix 7*) is used to verify what the human ear can hardly perceive.

Rationale

The rationale behind our concern for rhythm stems from the fact that rhythm appears to be the weakest link in the training of both students and teachers. Unlike word stress, it is hardly ever taught and corrected by EFL teachers in my experience as a learner and as a teacher. A poor mastery of rhythm, which is closely connected to intonation, could easily lead to ambiguity or

misunderstanding, or even to a total break in communication. Moreover, a good mastery of the rhythm of a language is a feature that gives an enviable native-like touch to non-native speakers of English.

Objective

The present research addresses these points and hopes to find tentative answers to a number of issues. The main one is to give a fair picture of what the state of the art is regarding rhythm in Oran schools. Rhythm is studied in its two aspects of stress-timing in the 25 conversational utterances on the one hand, and of isochrony in a traditional rhyme on the other. We wish to achieve this by measuring our local teachers' performances and comparing them with the native speakers' whose realisations set the norm to attain, and eventually suggest ways to remedy the weaknesses diagnosed.

Another question is to see whether the listener's subjective impressionistic judgement regarding the quality of an utterance can be confirmed by objective instrumental analysis. We wish to achieve this by putting some selected local informants' performances to the test of instrumental investigation.

A third question we wish to find an answer to is the part rhythm plays in communication, in other words, if a poor realisation of rhythm can lead to total lack of intelligibility and make communication extremely frustrating.

Another point we want to raise is whether there are any differences between male and female teachers, young teachers and old hands. We should get the answer to this question by ranking the individual teachers' performances and referring to the questionnaires all the informants filled in to see if some patterns do emerge along those lines. A copy of the questionnaire is available in *Appendix 5*.

A final point would be to suggest ways and means whereby to introduce and /or improve the teaching of rhythm in our schools.

Chapter One: Theoretical Background

Introduction

This chapter sets the theoretical background behind rhythm and the part it plays in languages, and more specifically in English, with a special focus on its manifestation in stress-timing and isochrony. One issue it addresses is the various realisations of rhythm by the speakers and how these are perceived by the listeners. Another one is to see whether instrumental investigations in acoustics confirm or invalidate attractive long-standing theories. In a nutshell, we wish to discover the current state of the art in the study of rhythm.

Rhythm in Speech

General Definition of Rhythm

In all the arts, rhythm is the element that provides a universal means of communication. Rhythm is the natural swing felt in dance, music, and language. The word comes from the Greek *rhythmos*, meaning measured motion. In dancing, rhythmic patterns and variations are created by physical motions of shorter or longer duration and of greater or lesser emphasis. In music, rhythmic figures and phrases come from an arrangement of tones, organised according to their duration and stresses, or accents. In language, rhythm is the rise and fall of sounds according to syllables, vocal inflections, physical speech accents, and pauses.

The debate over whether there is rhythm in speech dates back to the eighteenth century. Lord Burnet cast doubts on the existence of rhythm in his 1774 paper on the origin of language. He considered the phenomenon to be something that if existing at all, only scholars could perceive (Burnet 1774).

In 1775, Steel asserted the existence of rhythm in both poetry and prose, comparing the succession of both heavy and light syllables in speech to the up and down motion of the human foot when walking (Steel 1775, 87 ff).

Both teachers and students are aware of the existence of some kind of rhythm in language, but a question worth raising is when people actually started getting interested in the existence of rhythm in language and what part, if any, it plays in speech.

We will focus on rhythm first as regards its role in stress-timing, and then in the part it plays in isochrony.

What research says about rhythm in speech

Researchers, such as Pike (1945), Abercrombie (1967), Fox (2000) among others, accept the idea that speech exhibits rhythm. But precisely what physical events contribute to the acceptance of rhythm as a feature of speech is rather elusive. This has led to the widely held view that rhythm is a perceived effect which may or may not have reliable acoustic correlates (Hay and Diehl 1999, among others). Rhythm imposes structure on sequences. It has an 'organising' function (Allen and Hawkins 1980).

Rhythm is a regularly recurring sequence of events or movements which include a beat or stress. There has been a long-standing debate in the study of rhythm as to whether the presence of the stress (accent) or the regularity of recurrence (isochrony) is more important. Beyond these two features, a third characteristic of rhythm is that it creates the expectation that the regularity of succession will continue (Abercrombie 1967).

Speech rhythm, according to Fox (2000), organises speech into regularly occurring temporal units. In this way the predictability of speech events is increased and, by the same token, the intelligibility of utterances (Lehiste 1970). Research has shown that listeners are particularly sensitive to stressed syllables and are able to predict when they occur. This allows listeners to concentrate their attention on those events which highlight the semantically significant parts of an utterance. "Rhythmic structure produces useful perceptual redundancy in speech by constraining the time when (important) articulatory events may occur." (Allen and Hawkins 1980, 229)

All the researchers mentioned above seem to agree with the idea that rhythm cannot be separated from language communication, and that one cannot study language without studying its rhythm.

Syllable-timed versus stress- timed languages

There is a clear audible difference between the prosody of languages such as French, Italian or Spanish on the one hand, and that of languages like English, Russian, Dutch or German on the other. Lloyd James (1940) attributes this difference to rhythm and uses the metaphor "machine-gun rhythm" for the first group of languages and "morse code rhythm" for the second. The latter has also been defined as cannon ball rhythm. In the two groups, elements, syllable for the former, stresses for the latter, would recur at intervals to establish some form of temporal organisation.

The development, however, of a scientific framework for the treatment and classification of rhythm was only developed in the last century.

Pike (1945) and Abercrombie (1967) are often cited as having fathered the idea that some languages, like English, are stress-timed and that others, like French, are syllable-timed. The suggestion is that the units of rhythm for English are the time intervals from one stressed syllable to the next stressed syllable, while in French they are the time intervals from one syllable to the next. English has both stressed and unstressed syllables, whereas in French all the syllables are stressed, with the last syllable bearing the primary stress though in polysyllabic words.

Researchers have long debated these notions of stress-timed versus syllable-timed languages. Stetson (1951) argues that each syllable corresponds to an increase in air-pressure, air from the lungs being released as a series of chest pulses. He considers chest pulses as 'regular puffs of air' to produce a syllable, while stress pulses are reinforced chest pulses to accentuate a syllable and give it more force. The varying combination of 'chest pulses' and 'stress pulses' determines what rhythm a language has. Abercrombie (1967, p. 36) bases to some degree his theory of chest-pulses and stress-pulses on Stetson's work and explains the existence of rhythm in speech as a result of the breathing mechanism. In stress-timed languages, stress pulses are equally spaced but chest pulses are not, while in syllable-timed languages chest pulses are equally spaced but stress pulses are not, as for example in French: (C'est INcroyable).

Abercrombie formulates his famous stress- and syllable-timed hypothesis (SSH) and makes a convincing and appealing description of the theory. He considers SSH as a way to discriminate between languages and asserts that speech is regular and SSH applies to both verse and spontaneous speech. He notes "the close connection between ordinary speech rhythm and verse rhythm". For him, "the rhythm of everyday speech is the foundation of verse…." (1967, p. 98), but Jones (1960, p. 242) notes "the extreme difficulty of describing or reducing to rules the innumerable rhythms heard in ordinary connected speech". Pike does not share the same view and speaks of stress-timing as being controlled "strictly and mechanically in poetry - and possibly partially so in some types of elegant prose…" (p. 34). Abercrombie pushes his theory further and declares that all languages must of necessity fall within one of two categories: they are either stress-timed or syllable-timed. His SSH is, in fact, not a single hypothesis, but a collection of five different hypotheses, as explained below.

Can languages be considered as being exclusively stress-timed or syllable-timed?

Abercrombie's hypothesis includes the following five hypotheses or sub-hypotheses:

(a) all languages fall into one of two mutually exclusive categories: stress-timed (English, Russian, Arabic for example) or syllable-timed (French, Spanish, Italian for example). In a stress-timed language, between one cannon ball and another, there may be more than one syllable, while in a machine gun language, each bullet represents one single syllable.

(b) in stress-timed languages, stresses occur at equal time intervals (stress-isochrony), for example in counting from 1 to 20 and beating the rhythm by tapping on the table. It is easy to notice that numbers such as one, seven or eleven are all said in one beat although they have respectively one, two and three syllables. The same is true for many rhymes that can be said to the beat of a finger on the table irrespective of the number of syllables within each beat or measure.

(c) in syllable-timed languages, syllables occur at equal time intervals (syllable isochrony), as regularly as the bullets of a machine gun. For example, '*Nous allons à l'école*' would have six syllables of equal length.

(d) syllable length varies in stress-timed languages, but not in syllable-timed languages. For example, /can/ in /*yes, I can*/ is longer than /can/ in /*Yes, I can do it*/ with the sentence stress on /do/. This feature of the language gives foreigners the impression that native speakers swallow certain sounds.

(e) inter-stress-intervals vary in length in syllable-timed languages, but not in stress-timed languages.

These hypotheses are interdependent: (b) and (c) contain the defining characteristics (stress-isochrony, and syllable-isochrony) of the two categories that make up the binary distinction in (a). Thus if research evidence shows that either stress-isochrony (b) or syllable-isochrony (c) does not hold water, then hypothesis (a) is refuted. Hypothesis (a) would also be refuted if it was found that no language is characterised entirely by stress-timing, or if it was found that no language is entirely syllable-timed.

These hypotheses seem at first sight to be eminently testable, but as Roach (1982, pp 74-76) points out clearly, the methodological problems of testing the hypotheses are almost insurmountable.

A major problem lies in the difficulty of defining and clarifying the notion of syllable. Each syllable is a sound that can be said without interruption and is usually a vowel which can be preceded and / or followed by consonants.

However easy it may be to count the number of syllables in a word, there are no universally agreed upon phonetic definitions of what a syllable is. A layman's definition of a syllable is very practical and neat: any word can be divided into syllables. For example, everyone agrees that the word '*basket'* has two syllables. But where the first syllable finishes and the second begins is another matter. Is the first syllable /bɑ:/ and the second /skɪt/ ? Or is the first syllable /bɑ:s/ and the second /kɪt/? Or is the first syllable /bɑ:sk/ and the second syllable /ɪt/?

Researchers propose different theories. Five are mentioned below.

Phonetic Definition

According to Roach (2000, p. 70), syllables "are usually described as consisting of a centre which has little or no obstruction to airflow and which sounds comparatively loud; before and after that centre … there will be greater obstruction to airflow and/or less loud sound".

Phonological Definition

Laver (1994 p.114) defines the phonological syllable as "a complex unit made up of nuclear and marginal elements". Nuclear elements are the vowels or syllabic segments; marginal elements are the consonants or non-syllabic segments. In the syllable /*faint*/, the diphthong /eɪ/ is the nuclear element, while initial consonant /f/ and the final cluster /nt/ are marginal elements.

Prominence Theory

Attempts have been made to provide physiological, acoustic or auditory explanations and definitions of the syllable. According to the prominence theory, based mainly on auditory judgements, the number of syllables in a word is determined by the number of peaks of prominence. In the word /*entertaining*/ the peaks of prominence are represented by the vowels. However, this theory does not help much in the area of syllable division.

Chest Pulse Theory

The chest pulse theory discusses the syllable in the context of muscular activities and lung movements in the process of speech. Experiments have shown that the number of chest pulses, accompanied by an increase of air pressure, can determine the number of syllables

produced (Gimson, 1980, p. 56), thus allowing to associate the number of syllables with the number of chest pulses.

Sonority Theory

Another approach is presented by the sonority theory according to which the pulses of pulmonic air stream in speech "correspond to peaks in sonority" (Giegerich, 1992, p. 132). The sonority of a speech sound is discussed as regards "its relative loudness compared to other sounds" (Giegerich, 1992, p.132) and each syllable corresponds to a peak in the flow rate of pulmonic air. Thus nuclear elements, or syllabic segments, can be described as inherently more sonorous than marginal, or non-syllabic elements.

The question of syllable definition or division being outside the scope of this research, when the nature of an operation requires it, we try to bypass the issue by dividing words into syllables in exactly the same way for all the informants.

A second issue raised by Roach (1982) concerns the allowance for variations in tempo for the same informant. This confirms Lindblom (1963) who basically found that as a speaker produces a syllable faster and faster in a longer stretch of discourse, the articulators simply cannot move fast enough to reach target positions for the consonant and the vowel. The result is that as vowel duration decreases, "formant nuclei shift away from the target frequencies towards the patterns characteristic of the phonetic context". This is confirmed in our research when informants start saying the rhyme at a certain rate and as they gain more and more speed towards the end of the rhyme, they tend to 'swallow' certain sounds or say them in a an over-relaxed way.

Although there is ample experimental evidence against the stress- and syllable-timing hypothesis of speech rhythms (Roach 1982, Dauer 1983, Laver 1994), it remains however the prevailing view and still features in accounts of the rhythm of speech because no other hypothesis matches its attractiveness.

Inter-Stress Interval Length

As cited in Cauldwell (2000), both Roach (1982) and Dauer (1983) examine inter-stress interval length.

Roach (1982) investigates supposedly stress- and syllable-timed languages. He finds that the variability of inter-stress intervals is no greater in syllable-timed languages than in stress-timed languages. He discovers that the 'stress-timed' group of languages (against all

expectations) has greater variability in the length of inter-stress intervals than the 'syllable-timed' group. It would thus seem that inter-stress-interval length discriminates between the two groups of languages, but "in the reverse direction" of SSH hypotheses (b) and (e) listed above. In other words, the stress-timed group has greater variability in inter-stress intervals than the syllable-timed group. Roach however attributes these differences to extreme values for one individual and states that "the figures are better taken just as grounds for rejecting the hypothes(i/e)s rather than evidence for calling the stress-timed group syllable-timed." (p. 77).

This seems to show that rhythm is a universal property of the human perceptual apparatus, rather than one specific to either stress- or syllable-timed languages. The dichotomy between stress- and syllable-timed languages is therefore also problematic as it has not been possible to assign all languages to either one of the two classes. (Roach 1982).

Dauer (1983, 1987) proposes a different view of speech rhythm class. Like Roach (1982), she concludes that the evidence provided by instrumental studies means that the difference between the so-called stress-timed and syllable-timed languages cannot be found in the duration of inter stress intervals. Instead, the rhythmic make-up of a language is determined by its 'structural characteristics', either its syllable structure, or its stress system, and whether or not it allows vowel reduction. Besides, although there may be no significant differences between languages, differences exist rather between very fast and very slow speakers.

In languages traditionally classified as stress-timed, we find longer complex syllables associated with vowel reduction. Complex syllables refer to syllables containing consonant clusters in initial position (as e.g. in *strain*), middle position (as e.g. in *explain*) or final position (as e.g. in *texts*). Vowel reduction refers to various changes in vowel quality associated with decreased stress, duration, loudness, or articulatory effort. Its most common manifestation is the schwa [ə]. In fast speech, vowels are reduced due to a physical limitation of articulatory organs, i.e. the tongue cannot move in a proper position in time to produce a full-quality vowel. An example from our corpus might be Part 4 or 5 of the Rhyme which finishes with the word 'built' after a long stretch of words spoken more and more quickly. The word [bɪlt] is pronounced [bəlt].

For Dauer (1987) the stress system of stress-timed languages tends to be based on lexical stress which signals syllable prominence by changes in length, pitch, loudness, and/or vowel quality, whereas syllable-timed languages tend to have no word level stress at all or rely on pitch alone to mark prominent syllables. A complex set of rules for realising the stress is often

a characteristic of stress-timed languages. Dauer's account (1983, 1987) also makes it possible to accommodate "rhythmically mixed" languages, i.e. languages with some features associated with stress-timing and others associated with syllable timing. She speaks against the use of the word "timing", favouring the adoption of the term "stress-based". For Dauer, a stress-based language is one in which stress plays a large role in word-stress, syllable structure and vowel reduction. It is important to realise that for Dauer (1987), the term 'stress-based' constitutes the rejection of the notion of timing. She rather proposes to regard languages as being placed along "a more or less stress-based rhythm" rather than belonging to one of two mutually exclusive categories. She proposes the appellation of "stress-based/syllable-based continuum for this more or less stress-based rhythm". And indeed, a number of scholars (Laver, 1994 p. 258; Dalton and Seidlhofer, 1994, p. 42) credit her with being the originator of the 'stress-based/syllable-based continuum'.

Evidence from recent research is overwhelmingly against the hypothesis that languages are either stress-timed or syllable-timed, but astonishingly, SSH has survived its refutation, because in the absence of an alternative hypothesis, researchers continue to use it in their accounts of the rhythm of English (e.g. Cruttenden, 1997).

"It cannot be denied ...that...stress-time still represents an appealingly neat categorisation, so that references to stress-time (especially with regard to English) are still frequent". Dalton and Seidlhofer (1994, p. 110).

We focus next on the second part rhythm plays in languages, namely isochrony.

Isochrony

What research says about isochrony

Until recently, it was thought that rhythm in language resulted in isochrony, i.e. the regular recurrence of a specified speech unit which could be the mora, the syllable or the foot. The mora, equivalent to a short syllable, is the minimal unit in mora-timed languages such as Japanese and Tamil for example, (Crystal, 1991). In syllable-timed languages such as French or Spanish, the syllables are said to occur at regular time intervals, or what Crystal (1991) calls 'isosyllabism'. The third unit is the foot in stress-timed languages such as English or Arabic (Abercrombie, 1965; Abercrombie, 1967; Pike, 1945). In these languages, stressed syllables, called RUs in this research, fall at approximately equal time intervals. According to Halliday (1970) a foot starts with a stressed syllable and lasts to the following stressed one

which is included, while for Abercrombie (1967), the foot starts with a stressed syllable and includes all the following unstressed syllables up to but not including the next stressed syllable. The latter definition is the one that is generally adopted.

Pike (1945, 35) makes a clear-cut distinction between two types of isochrony, syllable-timing and stress-timing. Syllable-timed languages are said to have syllables which are of approximately similar duration, which implies that tone groups vary in duration, depending on the number of syllables they contain. A tone group is said in a single breath; in practice this variation in tone group length is limited. Thus, in a tone group with a great number of syllables, all the syllables might be said more quickly to "fit within a single breath", whereas in stress-timed languages, the interval from one stressed syllable to the next, is roughly equal, regardless of the number of syllables it contains. This means that some syllables, the unstressed ones, are spoken very quickly, while the stressed ones often have a much longer duration. If the tone group has an unusually big number of syllables, the rate of delivery might be speeded up, but the stressed syllables usually take relatively longer to realise than the unstressed ones. In English for instance, tone groups average about five syllables, though it is possible to have tone groups of only one syllable, as we have in 1RU_1Syl of Set 1, namely '*John'*, in answer to the question '*Who came?*'.

An instrumental phonetic investigation by Classe (1939) analyses the durations of English stressed syllables by means of a modern version of the kymograph. The basic principle of the machine is a revolving drum wrapped with a sheet of paper on which a stylus moves back and forth to record variations caused by pressure fluctuations or motion changes. The original machine was invented by physiologist Carl Ludwig in the 1840s. It is also known as a wave-writer, as its name implies. It was used to record temporal variations of any physiological or muscular process. Using a twentieth-century version of that kit, Classe shows that for "strict isochrony to occur, the syllables of a rhythmic group have to be similar with regard to number as well as phonetic and grammatical structure" (Classe 1939, p. 85). This is to some extent confirmed by our research. In NAS3's realisations of Utterance 1RU_3Syl (*She's alone*) and 1RU_4Syl (*She is at work*), which have the same number of stressed syllables, the same grammatical structure, and almost the same phonetic structure, there is strict isochrony, take or leave 9 milliseconds. Another example in our research is provided by NAS1 in her realisations of 2RU_5Syl (*She's taking a bath*) and 2RU_6Syl (*She's having her breakfast*) in 1,063 milliseconds and 1,065 milliseconds respectively. Classe concludes that true isochrony must be rare "as it may only occur through a complicated system of coincidences" (Classe

1939, p. 85), but continues that "it is still a characteristic which always seems to be present and to make its influence felt; although frequently, it only remains as an underlying tendency of which some other factor at times almost completely obliterates the effects." Shen and Peterson (1962), Bolinger (1965), O'Connor (1965, 1968), and Uldall (1971), all provide additional evidence for Classe's findings with their instrumental investigations.

More recent research also suggests that there is no one-to-one correspondence between the acoustic signals and linguistic units. This applies to what Couper-Kuhlen (1993, p. 14) calls "rhythmicity in speech". Even if there is no evidence for isochrony being contained in the acoustic signal, it remains true that listeners perceive isochrony in English speech (Couper-Kuhlen (1993), Lehiste (1977). Listeners, they say, tend to over-estimate the duration of shorter syllables and under-estimate the duration of longer ones. In "slips of the tongue" speakers of English, a stress-timed language, change the rhythmic make up of an utterance either by deleting or inserting syllables" so that syllables are more equally distributed.

In our research, some informants did just that. FAT04 and FAT23 for example added a syllable (a schwa [ə] between [dʒæk] and [bɪlt] as they actually said [ðɪs ɪz ðə haʊs ðət dʒæk ə bɪlt]*)* while others, FAT06 for example, actually deleted a syllable [ðɪs ðə kæt] intead of [ðɪs ɪz ðə kæt] , or MAT1 who made Utterance 3RU_5Syl (*It's raining too hard*) sound like a 2RU_5Syl by 'unstressing' a stressed syllable and saying [ɪts reɪnɪŋ tə hɑ:d] instead of [ɪts reɪnɪŋ tu: hɑ:d].

More recent work has shown that there is very little evidence for isochrony (Dauer, 1983; Dauer, 1987; Miller, 1984; Ramus et al., 1999; Roach, 1982) and yet one of the basic hypotheses behind rhythmic models remains that of isochrony, that is the organisation of speech into portions perceived as being of equal or equivalent duration.

There are two interpretations to this hypothesis.

One interpretation concerns strict isochrony which expects the different elements to be of exactly equal duration, as seen in the example given earlier regarding NAS1's production of two utterances: Utterance 2RU_5Syl '*She's taking a bath.*' and Utterance 2RU_6Syl '*She's having her breakfast.*' The utterances have a different number of syllables, namely five for the former (said in 1,063 seconds) and six for the latter (said in 1,065 seconds). They are said with practically the same duration, plus or minus 2 milliseconds, which is negligible in the

sense that on the one hand, it can never be perceived by the human ear, and on the other hand, it might be due to an acceptable margin of error on our part when recording the Wasp realisations..

The second interpretation is that 'weak isochrony' which claims that there is a tendency for the different elements to have the same duration; hence, a constituent containing five sub-constituents, for example, will be less than five times as long as a constituent containing only one sub-constituent. This is also confirmed by our research. For example, in Set 3, the number of sub-constituents as they are called, increases by 267% from 3 in the first utterance of the set: '*Ann left Bill'* to 8 in the last utterance of the set: '*I saw the accident happen*.' The time taken to say the two utterances by NAS4 for example increases by only 137% from 0,951 second to 1,302 second.

The most frequently used model of English rhythmic structure is one in which phones are grouped into syllables (or into the intermediate sub-syllabic constituents of onset, nucleus and coda, as in for example the / k/, the /æ/ or the / t/ of /cat/ respectively). Syllables are combined into feet. For example, in Set 1 in our corpus, the utterances vary in the number of their syllables from one ('*John'*) to four ('*He is at work'*), but they all make up one single foot, or rhythmic unit as Halliday (1970) calls it. One foot may make up an intonation unit as in Set 1 in our corpus. But feet in turn may be grouped into intonation units, or sense groups, or breath groups, as in the Sets 2, 3, 4 or 5 of our corpus.

The definition of foot adopted in this research is that of Abercrombie. The foot starts with a stressed syllable and includes all the following unstressed syllables up to, but not including, the next stressed syllable. Therefore, his definition of the foot does not take into account word boundaries. A typical example is Utterance 3RU_7Syl ('*I'venever seenher dancing'*). The duration of feet is not strictly proportional to the number of syllables they contain; instead, syllables tend to be compressed when they are more numerous. This is very clear in our corpus. For Set 1 for example, the utterances vary from one to four syllables in length. But the duration is not multiplied by four. The mean duration of the native speakers' realisations moves from 0,354 to 0,769 second respectively. While the number of syllables is multiplied by 4, the mean duration is only multiplied by 2,172. For Set 4, it is even more evident. The number of syllables almost trebles from four to eleven while the mean duration of the native speakers' performances varies from 1,137 second to 1,851 second respectively. While the number of syllables is multiplied by 2,750, the mean duration is multiplied by 1,628 only.

Scholars such as Abercrombie (1967), Halliday (1970) and Ladefoged (1975) for example were influenced by the teaching of Jones. They introduced the notion of stress or accent and emphasised that a word having the potential for stress on a syllable when spoken in isolation, may lose that stress in connected speech. In our corpus for example, Utterance 2RU_7Syl (‘*We listened to some music’*.), we expected the words /to/ and /some/ to be unstressed and therefore spoken with a schwa in [tə] and [səm] as realised by native informant NAS4 rather than with [tʊ] and [sʌm] as realised by Algerian female informant FAT09.

Isochrony as a perceptual phenomenon

Isochrony refers to the idea that English has a strong tendency towards being a stress-timed language in which beats fall at roughly equal intervals, and native speakers of English either speed up or slow down the syllables between beats to make the beats equally spaced.

Observations of isochrony as a dominant feature of speech rhythm turn out to be a matter of perceptual reality rather than of physical fact (Donovan and Darwin, 1979).

Many researchers have investigated the acoustic signal of a number of languages in the hope of finding some measurable parameter which might be responsible for ‘triggering’ the perception of regular rhythm. Lehiste (1977) and Buxton (1983) conclude that the effect is a perceptual phenomenon, with listeners ‘latching onto’ stressed syllables which may carry a higher semantic load.

Some researchers have had recourse to various transformations of the data to try to come up with an isochrony model at the acoustic surface. Thus we find the early work of Hill, Jassem and Witten (1984) trying to find an index based on some intrinsic period in rhythmic unit repetition. They use an elaborate statistical technique in their quest to find isochrony in the acoustic signal.

Whether this isochrony is objective and could be analysed and measured instrumentally, or subjective and only a matter of perception, English is undeniably considered isochronous by speakers and listeners alike. The speakers can add, reduce or even elide a syllable to distribute the stresses evenly and achieve some form of temporally equidistant units, and the listeners can detect it consistently. All three situations of addition, reduction and elision have occurred in our research, as mentioned page 14 of this document.

There is another reason for the permanence and attractiveness of SSH: it sounds so easy to demonstrate. For example Underhill (1994, p. 71), writing for teachers of English as a second

or foreign language, suggests working through the following sequence of utterances, speaking the prominent syllables at the same rhythm, in spite of the increase in the number of intervening syllables, which is somewhat similar to what we call *Forcing Isochrony* in the last chapter of this research.

a.	YOU		ME		HIM		HER
b.	YOU	and	ME	and	HIM	and	HER
c.	YOU	and then	ME	and then	HIM	and then	HER
d.	YOU	and then it's	ME	and then it's	HIM	and then it's	HER

Couper-Kuhlen (1993) uses listeners' perceptions to identify 'isochronous chains' in English. Two informants analysed a two-minute extract from a phone-in radio programme broadcast consisting of 23 turns of varying length between the host and a caller. The informants listened to the corpus several times, looking for stretches of speech they could tap a pencil or nod their heads to. The informants identified 48 isochronous chains in the recording, but 36% of all syllables, and 17% of stressed syllables, occurred outside the 48 isochronous chains.

Couper-Kuhlen (1993, p. 48) concedes that English is not 100% stress-timed: "English speech is not uniformly isochronous over extended periods of time". She immediately qualifies this statement: "But just as significantly, the passage is not wholly unisochronous either. In fact, allowing for discontinuities, a large portion of it is isochronous in one way or another."

For Couper-Kuhlen, English is not isochronous when viewed from the "macro-perspective of the entire temporal extent of a spoken text", but from the 'micro-perspective' of the internal characteristics of each of the 48 chains selected it is isochronous.

Whatever perception is bringing to the cognitive assignment of isochrony, the question of whether this act is mediated by an acoustic signal to which the listener is sensitive – as evidenced by the detection of errors – remains open.

Acoustic Approach

The mechanism of speech is a very complex phenomenon. In order to undertake any analysis of language, it is important to understand the various processes that combine to make up the message that a speaker transmits and a listener receives.

Unless our ability to produce and understand speech is somehow impaired one way or another, that human aptitude is so much part of us that we take it for granted and give little

thought to its nature and function. It is not surprising that many people overlook the great influence of speech on the development and functioning of human society.

What makes speech so important is the part it plays in the development of human culture. This progress is made possible, to a great extent, by our ability to communicate with others, to air and share experiences, to cross-fertilise ideas and to transmit knowledge from one generation to the next.

As Pr. Dekkak puts it in his lectures, “Speaking is modified breathing”. Not unlike speaking, breathing is a rhythmical activity which involves taking air in and out on average about fifteen times a minute; the actual rate may increase or decrease depending upon the degree of physical activity. In quiet breathing, the inspiratory and expiratory phases of the cycle take about an equal time, whereas in speaking egressive languages, we use only the outflow phase to supply energy. Since air is being continuously expelled from the lungs, the alternate opening and closing of the vocal folds results in the emission of successive puffs of air into the space above the larynx and it is this stream of pulses that is at the origin of the sound generated by the larynx. Vibration of the vocal cords, powered by air coming from the lungs during exhalation, is the sound source for voiced speech.

These sound waves travel through the air from the speaker to the listener. The sound waves of speech are among the most complex to be found in nature, particularly in the sense that extreme changes in sound quality follow each other very rapidly. These waves can be studied from different aspects: amplitude, pitch and duration.

The Technique of Frequency Analysis

Frequency is defined as “the number of complete cycles that take place in one second.” (Denes and Pinson, 1973, p. 26).

For example, if fifty total cycles occur in one second, it will be said that the sound wave has a frequency of fifty cycles per second, or fifty Hertz. A cycle depends on the movement of air particles from a rest position A to another position B, then back to the initial rest position A.

The time taken by one cycle or one oscillation to be accomplished is the period or the duration known as T of the vibratory phenomenon. The frequency F is determined as follows: F= 1/ T where F is measured in Hertz/ cycles per second and T (time) in seconds.

The fundamental frequency of a sound (Fo) corresponds to the openings and closings of the vocal cords; in fact, it determines its pitch, which is its auditory correlate. The property of a

sound may shift from high to low following the rate of vibrations of the vocal cords. Thus the more vibrations, the higher the fundamental frequency, and the higher the pitch, and, conversely, the fewer the vibrations, the lower the fundamental frequency and naturally, the lower the pitch.

Speech sounds are made clear in terms of a three-dimensional visual record in which time in seconds is displayed horizontally, frequency in Hertz vertically and intensity by black blocks technically called narrow band and wide band spectrograms.

Narrow-band and wide-band spectrograms

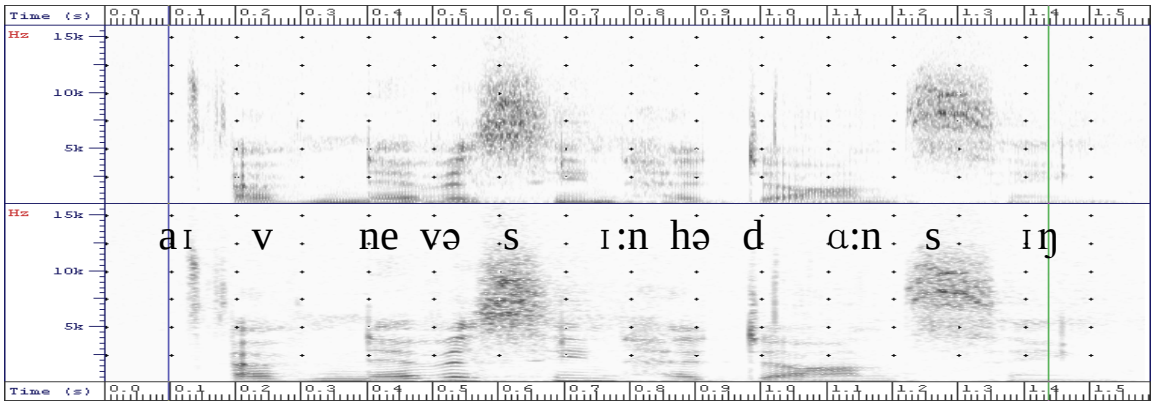


Fig 4 Top band is the wide band with vertical striations.

Lower band is the narrow band with horizontal striations

A narrow band spectrogram is made up basically of horizontal lines. The horizontal lines in the narrow band spectrogram are the slices on the frequency scale. It is, therefore, good in frequency resolution, but poor in time resolution. The wide band spectrogram is, on the other hand, composed of vertical striations. It is poor in frequency resolution, but good in time resolution. It can see events that succeed each other with intervals longer than three milliseconds. It has been found that for most purposes in the acoustic study of speech, the wide band analysis is more useful than the narrow band.

Chapter Two: Corpus, Informants, Experimentation

Introduction

In this chapter, a first section presents the software and the hardware used in this research. The software concerns the selection of the different components of the corpus, one made up of conversational utterances (*see Appendices 2 & 3*) aimed at studying stress-timing, and the second made up of a traditional British rhyme (*see Appendix 4*) aimed at studying isochrony. The hardware concerns the laptop (see Appendix 10) and the microphone (see Appendix 9) used for the recordings as well as the tools, such as WASP (*see Appendix 6*) used to calculate duration, amplitude and pitch, or the metronome to measure 'bpm' beats per measure or beats per minute (*see Appendix 7*).

Another section describes how the informants, British native speakers and local teachers, were chosen, the questionnaire (*see Appendix 5*) they were asked to fill in and the instructions they were given.

A few words are said about how the corpus is archived for easy reference.

A final section in this chapter is devoted to describing the various procedures and operations used in our experimentation.

The Corpus

In dealing with stress-timing (ST), the corpus must of necessity be oral. Originally we aimed to analyse ST in an authentic communicative setting. Brazil (1995) rightly says that spontaneous speech is "speaker-controlled, purpose-driven, interactive, co-operative, context-referenced and context-changing". Unfortunately, that is almost impossible to achieve and extremely difficult to analyse. The second best was to identify, from authentic speech, a series of twenty-five conversational exchanges to fit the number of stressed and unstressed syllables we wish to analyse. We call initiators the first part of the conversational exchanges, very often but not always a question; and rejoinders the second part of the exchange, always a statement. A special effort was made to select utterances with the stressed syllable or Rhythm Unit or RU in initial position, in middle position and in final position in the second part of the exchange which is the subject of our research. Here are a few examples.

Example 1:	Initiator: Who called?	Rejoinder: John.
Example 2:	Initiator: Look at Mary.	Rejoinder: I've never seen her dancing.
Example 3:	What a coffeeholic!	Rejoinder: I started drinking tea recently.

As a substitute for spontaneous speech, we wanted to have the informants 'speak' the rejoinders from a script. Unfortunately, a great number of them just read the utterances aloud instead of speaking them. We had to make do with that kind of performance.

Although we realise that reading aloud is not a natural skill (What would one think if one saw or heard a person reading a newspaper or a train time-table aloud?), we accepted it because this is what happens in our classrooms.

The corpus on which the research is based is made up of two types of items.

Type one: Twenty-five utterances

Type one contains five sets comprising a total of twenty-five rejoinders or utterances, (see *Appendix 2: Initiators and Rejoinders* and *Appendix 3: The Rejoinders in Phonetic Script*).

The data for this part of the corpus is distributed as follows:

- In the first set of utterances, there is one rhythm unit in each of the four sentences, represented in this paper as 1RU_and the number of syllables increases from one to four: (1RU_1Syl, 1RU_2Syl, 1RU_3Syl, 1RU_4Syl).

  In Set 1, the sentences, or rejoinders, or utterances as we call them in this research are:

  - 1RU_1Syl John.
  - 1RU_2Syl She left.
  - 1RU_3Syl She's alone.
  - 1RU_4Syl He is at work.

- The second set of utterances is formed of two rhythm units in each utterance (2RU) and the number of syllables increases from two to seven (2RU_2Syl, 2RU_3Syl, 2RU_4Syl, 2RU_5Syl, 2RU_6Syl, 2RU_7Syl).

- In Set 2, the rejoinders, or utterances in this research are:

  - 2RU_2Syl John Smith.
  - 2RU_3Syl John and Ann.
  - 2RU_4Syl I like it rare.
  - 2RU_5Syl She's taking a bath.
  - 2RU_6Syl She's having her breakfast.
  - 2RU_7Syl We listened to some music.

- The third set of utterances is formed of three rhythm units (3RU) in each utterance, and syllables increase from three to eight: (3RU_3Syl, 3RU_4Syl, 3RU_5Syl, 3RU_6Syl, 3RU_7Syl, 3RU_8Syl)

  In Set 3, the utterances are:

  - 3RU_3Syl Ann left Bill.
  - 3RU_4Syl He bought two cars.
  - 3RU_5Syl It's raining too hard.
  - 3RU_6Syl I have a lot to do.
  - 3RU_7Syl, I've never seen her dancing.
  - 3RU_8Syl I saw the accident happen.

- The fourth one contains four rhythm units (4RU) in each sentence and the syllables are from four to eleven: (4RU_4Syl, 4RU_5Syl, 4RU_6Syl, 4RU_7Syl, 4RU_8Syl, 4RU_9Syl, 4RU_10Syl, 4RU_11Syl)

  In Set 4, the utterances of the corpus are:

  - 4RU_4Syl John left home late.
  - 4RU_5Syl Bill shouts all the time.
  - 4RU_6Syl She bought a new French car.
  - 4RU_7Syl He likes horror films a lot.
  - 4RU_8Syl I used to play tennis a lot.
  - 4RU_9Syl I started drinking tea recently.
  - 4RU_10Syl I fell in love with a beautiful girl.
  - 4RU_11Syl I'm leaving on vacation next Saturday.

- The fifth set of utterances is composed of a single utterance made up of five rhythm units and five syllables (5RU_5Syl). It was impossible to find in normal conversations an utterance containing only stressed syllables. The utterance was therefore invented for the occasion. In Set 5, the utterance is: 5RU_5Syl John Smith Loves Ann White.

However hard we tried, it was impossible to find utterances of six syllables made up exclusively of monosyllabic lexical words.

The stressed syllables, or Rhythm Units, or RUs as referred to in this research, have been written in bold and in colour to help the informants focus on rhythm.

It is worth noting that all the utterances (except 5RU_5Syl) are authentic utterances taken from normal conversations with or by native speakers, or heard on English language TV Channels, or read in books. As mentioned earlier, we tried to focus an authenticity, and avoid artificial sentences made up especially for the occasion. We made it our duty to find authentic utterances, giving as true a picture as possible of 'natural' conversational exchanges.

The second part of the corpus is made up of a traditional English rhyme, *This is the house that Jack built.*

Type two: A rhyme.

Halliday (1967, 1970, 1985) makes a neat distinction between foot-timing and syllable-timing. He acknowledges that English is not as isochronous in natural speech as it is in counting or rhymes (Halliday 1985, 272). He, thus, concludes that isochrony is phonological and the phonetically irregular realisation of inter-stress intervals can be disregarded (Halliday 1967, p.12).

We could not anticipate how closely our informants would adhere to stress-timing and isochrony in their realisations of the twenty-five utterances. To be on the safe side, we thought we could force them somehow by including in our study an English traditional rhyme. We hesitated between *Jack and Jill* and *This is the house that Jack built*. The latter appeared to be more popular amongst our informants and, although we used only 5 of its parts, it was still longer than *Jack and Jill* and could hopefully yield up more about isochrony.

All in all, our corpus contains 5 sets totalling 25 sentences, which are referred to as Utterances plus the Rhyme, divided into 5 parts.

Archiving

We had to find a neat way to archive our informants' realisations that could cater for the nationality of the informant (British or Algerian, i.e. native or non native), the sex of the informant (male or female), the item under study (utterance or part of the rhyme), the total

number of syllables in the utterance (from one to eleven) and the number of stressed syllables (from one to five)..

We ended up with the following acronyms:

NAS#: Code number of the Native Speaker of English, that is one of the four British informants whose mean performance durations, increment rates set the norms with which the local teachers' performances are compared.

FAT#: Code number of the Female Algerian Teacher, that is one of the twenty-five female local informants.

MAT#: Code number of the Male Algerian Teacher, that is one of the five male local informants.

#RU_ Number of Rhythm Units in a given utterance, which goes from 1 to 5 since the utterances contain between one and five Rhythm Units, our working definition for stressed syllables.

#Syl Number of Syllables in a given utterance, which goes from 1 to 11 because the utterances contain between one and eleven syllables, including stressed and unstressed syllables.

Part# Number of the Part of the Rhyme *This is the house that Jack built*, and that goes from 1 to 5, since five parts of the Rhyme have been used in the research.

This sentence outside the corpus can clarify things: *'John and his wife are leaving'* spoken by a *female Algerian teacher* of English who is number 3 on our list, archived as: FAT03 3RU_7Syl because the speaker is a Female Algerian Teacher (FAT); she is number 3 on our list of 25 such informants (FAT03); and the utterance contains 3 Rhythm Units (3RU) and 7 syllables (7Syl) in all, that is 3 stressed syllables (in bold capitals) **JOHN** and his **WIFE** are **LEA**ving (3RU) and four unstressed syllables (in small italics) JOHN *and his* WIFE *are* LEA*ving*: 3 stressed syllables (3RU) + four unstressed syllables makes 7 syllables (7Syl).

Instructions Given to Informants

The informants, both Algerian teachers (FAT and MAT) and British native speakers (NAS), were asked to say five sets of utterances as 'naturally' as possible, following the terminology used by O'Connor and Arnold (1973). By 'naturally', we understand three things: the utterance must be 'pause-free', 'attitude-free', 'contrast-free'.

Firstly, each utterance is meant to contain one sense group (or intonation group or tone group, or breath group as it is called sometimes in the literature) and one sense group only, whether it contains one syllable like the shortest utterance, or eleven syllables like the longest utterance. This implies that there should be no pause or pauses within a given utterance.

Secondly, each utterance is meant to be a 'neutral' statement with a mid-fall tune on the final RU, unless the nature of the lexical item requires differently, as in, for example '*She bought a new French car'* or '*I fell in love with a beautiful girl'*. In such cases, we accept realisations in which the moving tune falls on '*new'* or '*French'* instead of '*car'* for the former, and on '*beau'* instead of '*girl'* for the latter.

Thirdly, the utterance should have an 'unmarked' intonation contour, implying that no function word should carry the moving tune. For example, in the utterance 'He is at work' the stress should fall on WORK and not on HE for example, nor on any other word to indicate contrast.

The following figures indicate what is meant by a single sense group, 'unmarked' and 'neutral' intonation contour, using the terminology found in O'Connor and Arnold (1973).

First let us see what utterances can be discarded and why.

Marked attitude

Although the following utterance (Fig 5) has the moving tune on its last RU, it is not neutral because it is said with a fall-rise intonation pattern instead of a mid-fall. Such a realisation is discarded as it does not meet the criteria set.

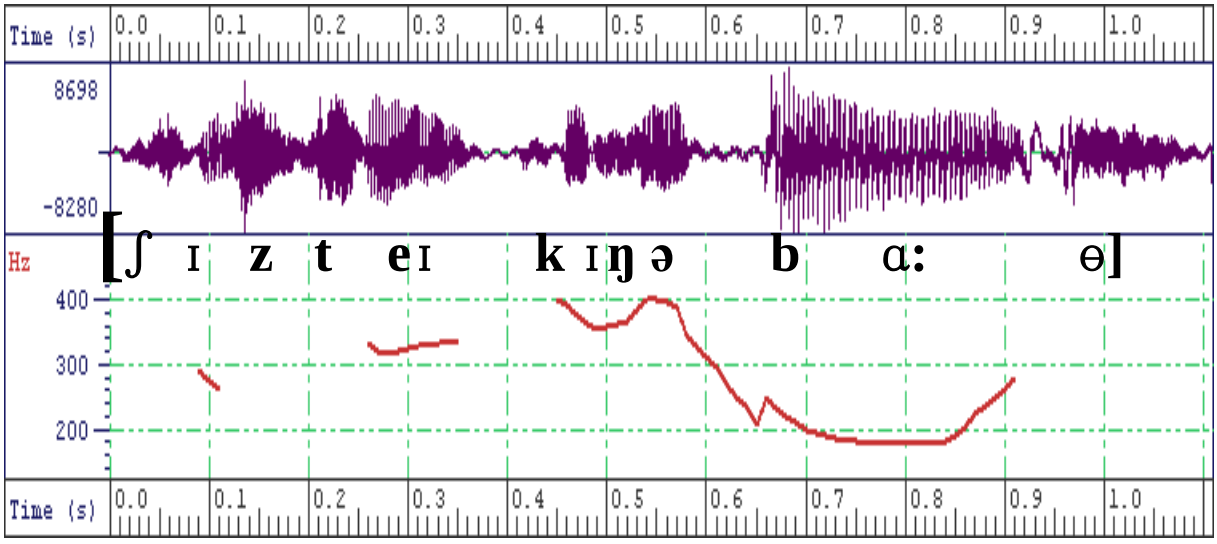


Fig 5: Untargeted marked fall-rise contour

Marked Contrast

The following utterance cannot be accepted either because the moving tune does not fall on the last RU. Therefore such a realisation would also be discarded.

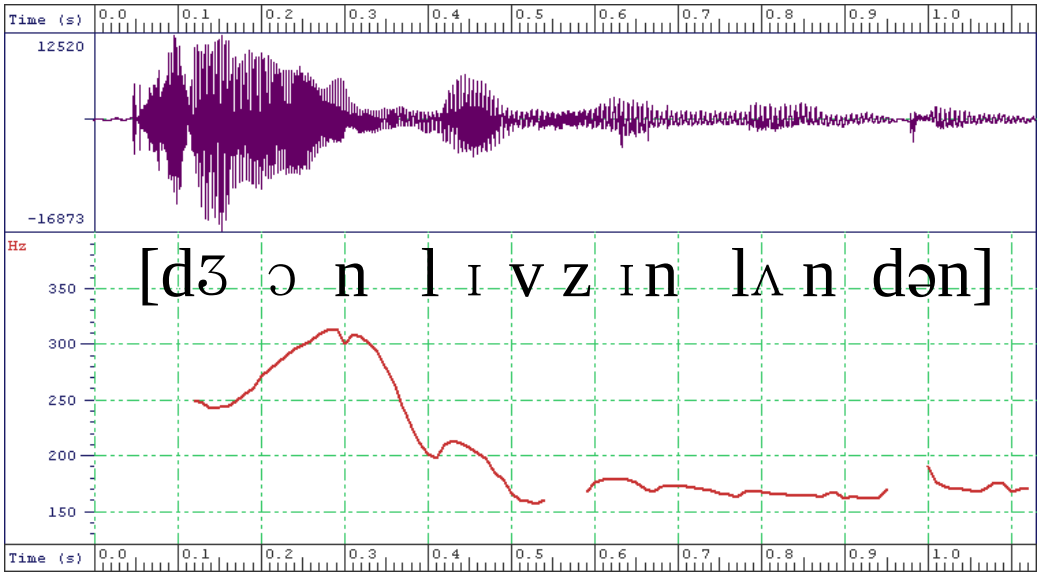


Fig 6: Untargeted marked utterance

Two sense groups instead of one

The following utterance (Fig 7) would also be rejected because it contains more than one sense group as indicated by the pitch variations.

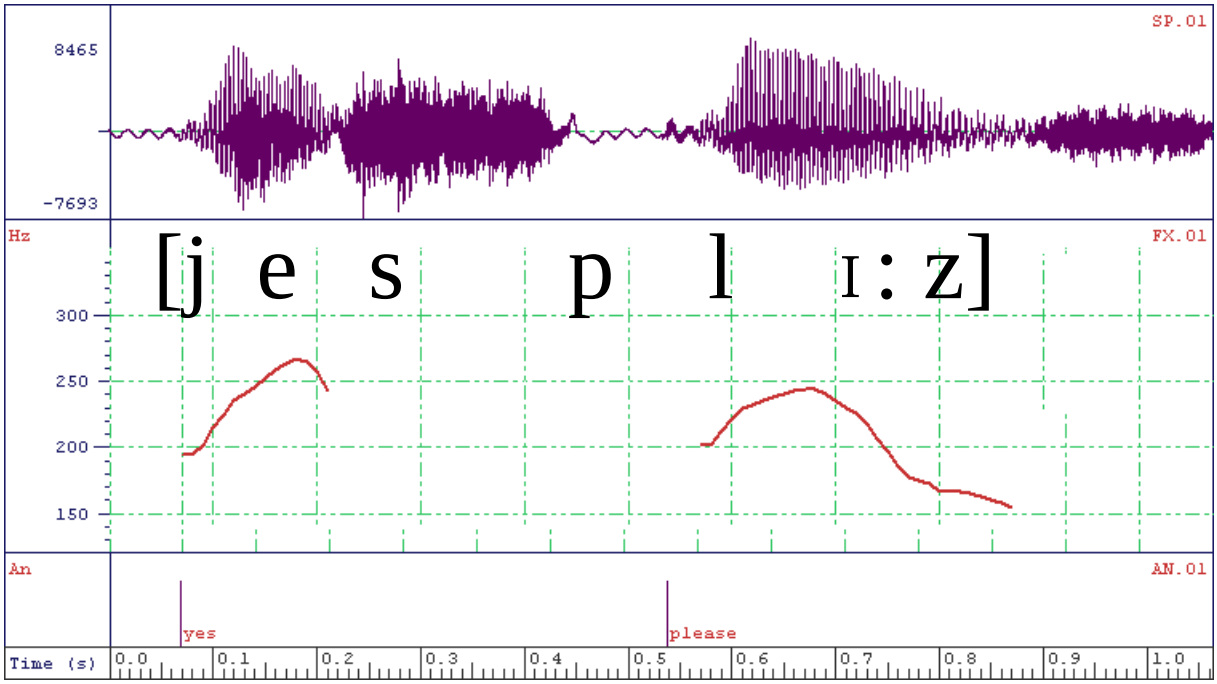


Fig 7: Untargeted two-sense group utterance

Targeted Utterance Form

Last but not least, here is the sort of utterance we are aiming for: an utterance spoken in one sense-group with a mid-fall tune on its last stressed syllable, as in the following example.

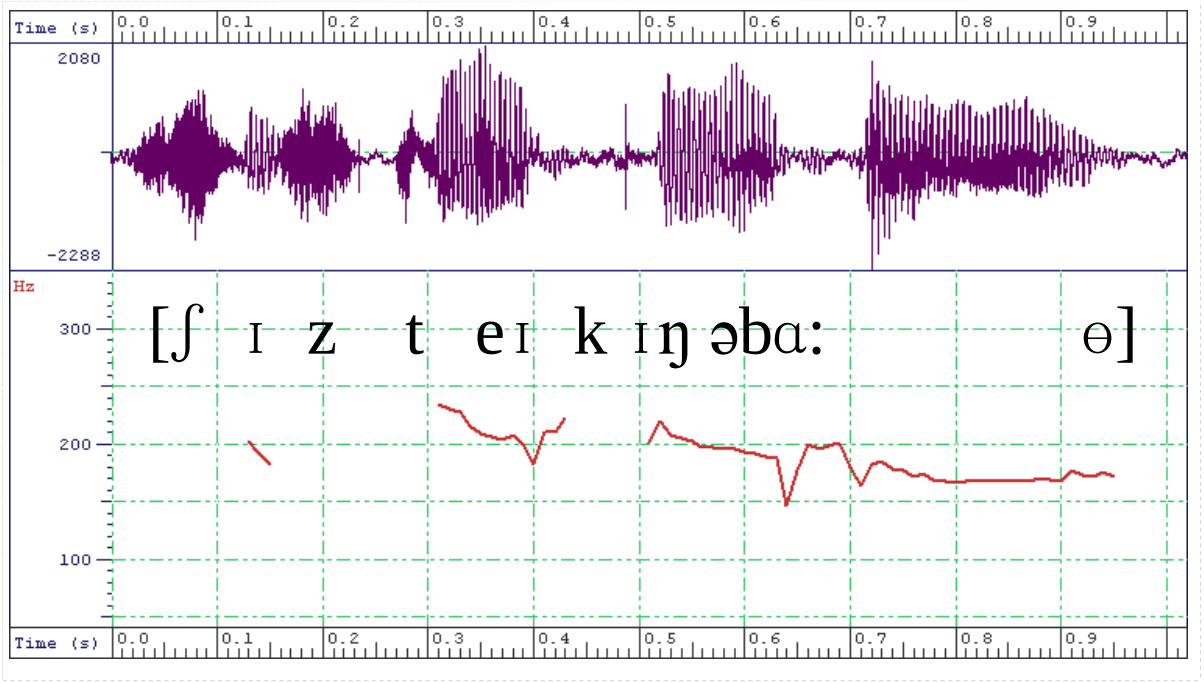


Fig 8: Targeted Utterance: one sense group, with a midfall tune on the last RU

The Informants

We need male and female Algerian teachers and the cooperation of British informants to fix the norms to be attained by the Oran teaching community.

Algerian Teachers

An encouraging number of teachers accepted our invitation to act as informants for the present research. We selected thirty to be a representative sample and to give as fair a picture as possible of the teaching population in Oran or just over 13% of the English teaching population in the Wilaya[2]. We aimed to cater for the following sociolinguistic criteria:

- **gender**: we have five male and twenty-five female teachers of English as informants,
- **seniority**: we have neophytes and old hands in terms of years of teaching,
- **geographic distribution**: we have teachers from the city and from other towns of the Wilaya of Oran,

[2] According to Mr M. Louznadji, Inspector of English in Oran, there are 221 teachers of English in the area, of whom an overwhelming majority are females.

- **age**: some are fresh College graduates while others are on the verge of retiring.

Questionnaire

In anticipation of what the findings of the various analyses might reveal, we asked a maximum number of questions to find out what, if any, might influence positively or negatively such or such realisation on the part of a given local teacher.

Native Speakers

British English being the variety taught at Colleges and schools in Algeria, we had to find educated British informants. We had appointments with two male Britons but the meetings never materialised. We managed to find four female representatives. They come from all walks of life: one State Registered Nurse from London, one teacher of English and French from Oxford, one Business Studies and Accountancy graduate from Newcastle, and one A-levels originally from Ireland but who spent the last twenty years in London.

Once the informants were gathered, we proceeded to the recordings along the instructions mentioned above. Many recordings had to be re-done several times to meet our criteria. Several recordings were discarded and replaced by those of new informants.

Techniques Used for Evaluation

Two techniques are used in the study: subjective human ear evaluation of the quality of rhythm in an utterance or a part of the rhyme, and objective instrumental analysis.

Human Ear Perception

Firstly, human ear perception is used. A panel made up of native speakers and Algerian teachers besides me listen separately, several times, to the different parts of the corpus, i.e. the 25 utterances and the rhyme. Instructions are given to concentrate on rhythm and to try and ignore such aspects as sound mispronunciations, rate of delivery, absence of juncture, intonation, etc. The instruction given is to detect stress-timing and / or isochrony in the local informants' realisations and to rank the performances from 4 to 1 in decreasing order of respect of rhythm, 4 being the best and 1 being the poorest. The final mark is the average obtained from the various individual marks. The findings are set out in the next chapter.

The ultimate goal is to see in the end whether our subjective perceptions concerning the quality of a local teacher's performances are in any way confirmed or invalidated by scientific experimentation using more objective tools.

The second technique used concerns objective instrumental measurements.

Instrumental Analysis

Two measuring tools are used: WASP and the music Weird Metronome.

WASP

The realisations of all the informants, British and Algerian, have been recorded using WASP. Acoustic analysis through WASP (*see Appendix N° 6*) is used to provide the duration of each performance for all the items in the corpus. The means of the native speakers' productions set the norms to be attained by the non-native speaking informants, either individually, or as female or male groups. The Algerian informants' performances are weighted against the norm as explained below in the procedures. The analysis addresses the following criteria:

a) Timing, increment rates and means of all individual and group performances,

b) Individual or group deviations of the local teachers from the means or norms set by the native speakers in terms of duration or increment rate for the groups or the individual performers,

c) FAT and MAT groups standard deviations from the NAS means or norms to see where the group or the individual stands in relation to the means.

The operations dealing with individual performances are then used to correlate perceptual evaluation and experimental analysis. Those dealing with the FAT or MAT groups are used to give a picture of the state of the rhythm of English in Oran.

Metronome

The second measuring tool is the metronome (*see Appendix N°* 7). It is used to evaluate the native speakers' and to Algerians' individual realisations of the rhyme and to examine the extent to which they exhibit some form of isochrony. The instrumental investigation confirms or invalidates the human ear. In other words, when we listen to the realisation of the rhyme, and we can beat rhythmically with our fingers or a pencil on a table or by nodding our heads, will the blinks or sounds of the musical metronome confirm or invalidate the human ear? If it does, it proves ultimately that there is some form of true isochrony, at least in the rhyme.

It is also used in a phase we call *Forcing Isochrony*, a pedagogical procedure to assist the learners in respecting rhythm and reducing vowels in unstressed syllables, an operation quite similar to the one Underhill suggests (1994, p. 71) in the previous chapter, to assist teachers

of English in our schools devise means and ways whereby to train their students in the mastery of the rhythm of the language.

Procedures

Collecting Data

The first step is naturally to record the productions of all the informants via WASP according to the instructions mentioned earlier and to archive them for convenient reference. They constitute the raw material to be used in the various operations. This part of the section is given in the *Calculations Booklet* under Appendix 1, but is physically located at the end of this document. It provides the raw material and the results of the calculations of this research. The durations of each and every utterance and rhyme of the corpus are given in seconds, going down to the thousandth of the second. The recordings make use of the same software and the same hardware, laptop and microphone are used throughout the experimentation phase to avoid any unexpected interferences. The only variable, apart from the actual informants themselves, is the physical setting where the recordings take place. Most of the time, it is a classroom or the staff room in a secondary school. As can be expected, these places are far from soundproof, and the recordings lack that studio quality.

The recordings are originally made in WASP speech filing system (.sfs extension files); they are then converted into .wav extension files to make them easily accessible to any computer user. They are therefore available in two forms. The relevant WASP application is supplied with this research for easy access to the .sfs extension files.

All the data appears in the *Calculations Booklet* in the order in which the operations are presented in this research. For example, the first operation in Chapter Four is entitled: *Mean Durations and Increment Rates of Sets*. In the Calculations, we can read a similar title: *NAS Mean Durations & Increment Rates Chapter 4: Operation 1*.

The heading means that the page contains the results of the calculations used for the first operation in Chapter Four. It makes use of the rough data given in the first pages of the *Calculations Booklet*. The page concerns the NAS group. It calculates the durations of the utterances and the increment rates for each of the five sets of the corpus. In Chapter 4, there is a detailed explanation of how each result is arrived at, with an illustrated example from the NAS or from the MAT group, because they are lighter to handle (four or five informants respectively instead of twenty-five for the FAT group) and take less room in the document.

Utterance Durations

The durations in seconds, down to the thousandth of a second, of all the twenty-five utterances are calculated for each of the five sets. Here is an example concerning Set 1.

Set 1 RU	**John.**	**She left.**	**She's alone.**	**He is at work.**
NAS1	0,358	0,608	0,667	0,686
NAS2	0,417	0,771	0,811	0,921

FAT01	0,420	0,808	0,748	0,851
FAT02	0,436	0,953	0,696	0,773
MAT1	0,387	0,702	0,592	0,723
MAT2	0,290	0,717	0,629	0,584

The table above is a sample of what appears in the *Calculations Booklet*. As mentioned in the top left box, it concerns Set 1 that is the set containing utterances with one Rhythm Unit. All four utterances are given in full: John, She left, She's alone, He is at work.

The codes of the informants appear in the right hand column. As explained earlier, NAS refers to native speaker informants, FAT refers to local female teachers, and MAT refers to the male teachers. The number attached to each acronym refers to the order in which they were recorded.

The numbers in the other columns represent in seconds, down to the thousandth of the second, the duration of a given utterance by the informant whose code number appears on the left hand column. The table is then to be read as follows: Informant NAS1 said "John" in 0,358 second; "She left" in 0,608 second, etc.

In all the tables, the data is presented in the same order: NAS from NAS1 to NAS4, FAT from FAT01 to FAT25, and finally MAT from MAT1 to MAT5. Throughout this research, the NAS means (obtained by adding up the NAS individual performances and dividing them by four) constitute the norm against which the local informants' achievements are weighted.

Rhyme Durations

In operations involving the rhyme, our primary purpose is to detect some form of isochrony, be it 'strict' or 'weak' as mentioned in the previous chapter. The actual rhyme is divided into five parts of unequal length. The same WASP technique of time measurements is applied to

each of the five parts of the rhyme. Here is a sample of what appears in the Calculations Booklet concerning the rhyme.

	Rhyme Part 1	**Rhyme Part 2**	**Rhyme Part 3**	**Rhyme Part 4**	**Rhyme Part 5**
NAS1	1,145	2,657	3,168	3,974	5,843
NAS2	1,524	3,051	3,639	4,279	5,890
FAT01	1,464	3,777	5,060	6,562	7,713
FAT02	2,231	5,544	7,178	9,032	12,158
MAT1	2,043	4,026	5,836	6,448	8,719
MAT2	1,332	3,174	3,857	5,668	6,961

In the case of the rhyme as in all other cases, the data appears in the same order of informants. The numbers indicate the time taken by a given informant in saying a given part of the rhyme. For example, it has taken FAT02 5,544 seconds to say the second part of the rhyme which is made up of eight rhythm units and sixteen syllables, or 8RU_16Syl.

This is the rat that ate the malt that lay in the house that Jack built.

In comparison, it has taken NAS1 only 2,657 seconds to say the same part of the rhyme.

If we look at the same informants' realisations of Part 5, 16RU_34Syl, the duration is 5,843 for NAS1 and 12,158 for FAT02.

Duration of Stressed and Unstressed Syllables of Utterances

Vowel reduction is a key feature in stress-timing and isochrony. One of the analyses related to vowel reduction necessitates the measurement of the duration of stressed and unstressed syllables in eight utterances selected for their conversational values. The operation makes use of the rough data or raw material which appears in the first pages of the *Calculations Booklet,* together with the other data related to the utterances or to the rhyme. A short explanation is given as to what types of calculations are required and an example is supplied to make things more palatable. After that, the calculations are done for the other groups or individual informants as needed.

Here is a sample of what such a table looks like.

	I like it rare.	**like**	**rare**	**Duration of RUs**	**Duration of Unstressed Syllables**
NAS1	0,799	0,155	0,312	0,467	0,332
NAS2	1,118	0,240	0,503	0,743	0,375
FAT01	0,978	0,286	0,327	0,613	0,365
FAT02	1,002	0,244	0,301	0,545	0,457
MAT1	1,065	0,271	0,429	0,700	0,365
MAT2	0,743	0,156	0,347	0,503	0,240

The first column as usual displays the codes of the various informants, first the native speakers, then the female, then the male local informants. The second column gives the utterance selected, in this case '*I like it rare'* and below it the time taken by each informant to realise it. The third and fourth columns give the RUs of the utterance, in this case '*like'* and '*rare'*. They are the two stressed syllables of the utterance. In this specific case, there are two such columns, but there may be more or fewer depending on the number of stressed syllables in the utterance. The 'Duration of RUs' column is the sum of the two RUs of the utterance. The right hand column, entitled 'Duration of Unstressed Syllables' is the result obtained when the time indicated in 'Duration of RUs' (i.e. the sum of the two stressed syllables) is subtracted from the time indicated under 'I like it rare'.

Here is an example. MAT1 takes 1,065 seconds to say the utterance concerned. He produces the two stressed syllables in 0,271 and 0,429 second respectively. The RUs (0,271 + 0,429) add up to 0,700. The duration of the unstressed syllables is then the time taken for the complete utterance, (1,065) minus the time taken to say the stressed syllables (0,700) giving a remainder of 0,365 representing theoretically the time taken to say the unstressed syllables of the utterance.

Types of Operations

The different operations cover three stages and aim to achieve three different objectives. Here is a listing of the stages with a brief description.

The first stage makes use of all the recordings and relies on ear perception alone to evaluate the local informants' productions. It includes the rating and ranking of the latter by evaluators. Besides myself, the panel includes two native speakers and two Algerians selected for their competence as speakers of the language and as teachers. This is the concern of the next chapter.

The second stage deals with the utterances, as opposed to the parts of the rhyme, and is more stress-timing related. It includes three operations.

> The first operation calculates the means of the five sets and weights the means of the female and the male informants' realisations against those of the native speakers'.
>
> Another operation analyses 4 utterances containing a total 4 of syllables, with each time a stressed syllable replacing an unstressed syllable, until all the four utterances are stressed.
>
> A final operation calculates and compares the differences between stressed and unstressed syllables in the realisations of all the informants. All this appears in detail in Chapter 4.

The third stage is more isochrony oriented. It includes four operations.

> The first operation analyses the first utterance from each of the five sets, i.e. utterances containing one, two, three, four and five stressed syllables.
>
> The next operation analyses and compares the realisations of the different parts of the rhyme.
>
> Another operation tries to detect the presence or absence of differences between the realisations of a part of the rhyme and an utterance which have the same syllabic structure.
>
> The final operation introduces a new measuring tool, the musical metronome, to assess how close the realisations are from true isochrony. This is the object of Chapter 5.

It is worth noting from the outset that in the first stage, the main focus is on the local informants as individuals, while the second and third are concerned first and foremost with the informants as FAT or MAT groups.

Chapter Three: Ear Perception Analysis

Introduction

This chapter deals with the evaluation of stress-timing and/or isochrony as perceived by the human ear. Subjective analysis is a must since, as mentioned by Hay and Diehl (1999), Couper-Kuhlen (1993), Dauer (1982) and Roach (1983) and several others, rhythm is a perceived effect which may or may not have acoustic correlates that instrumental analysis might reveal.

The Operation

The current operation encompasses all the realisations, twenty-five utterances and five parts of the rhyme. The stated objective is to listen to all the recordings and assess the local female and male teachers' performances and respect of stress-timing. After that, the performers are given a score and ranked. To that end, a group of evaluators is set up. It consists, besides me, of two native speakers, and two experienced Algerian teachers known for their proficiency as teachers and near native-like competence as speakers of the language.

First, the evaluators are asked to listen individually to all the recordings several times and listen for the presence of pitch variations that make stressed syllables audibly more prominent than unstressed ones. They are also expected to spot any perceivable contrast between these two types of syllables. A corollary of this point is the presence or absence of vowel reduction in unstressed syllables and of weak forms in function words.

At the same time, the evaluators must be attentive to and be able to detect the presence of unnecessary pauses and their effect on the listener's ease of understanding. The panel is also asked to report on any abnormal realisation, such as adding a vowel, eliding a vowel, or stressing the wrong syllable for example. In a nutshell, the panel has to assess how close the individual informant's realisation is to the natives', or how far from it.

Scoring Grid

To ease from the burden of subjective scoring, the evaluators agree on the following criteria.[3]

A top mark of 4 is awarded to a near native like realisation, with well-paced flow that does not affect intelligibility in any way.

A mark of 3 is given when the realisations show fluidity of expression, with some minor pacing that may require listener effort at times. Overall intelligibility remains good, however.

[3] Criteria adapted from TOEFL iBT Test Integrated Speaking Rubrics. In TOEFL iBT Tips, New Jersey, 2005.

A mark of 2 is given when the realisations are basically intelligible, but listener effort is needed and pace is choppy and can obscure meaning at times.

A mark of 1 is given when rhythm difficulties cause considerable listener effort because of unnecessary pauses and choppy delivery.

All five evaluators acknowledge the difficulty of rating the various performances taking into account rhythm exclusively, disregarding intonation and consonant or vowel qualities, and so many other features unclassifiable by non specialists, but which may hinder communication.

Each evaluator gives a personal mark from four to one, trying not to be influenced by other types of mistakes (for example when '*bought'* is pronounced [bəʊt] instead of [bɔ:t]; or '*cow'* is pronounced [kəʊ] instead of [kɑʊ]; or '**tossed'** pronounced as [təʊst] instead of [tɔst] amongst many others). The different scores are divided by five and the performers ranked accordingly. The complete scores appear in the *Calculations Booklet* under 'Ear Perception Analysis : Scores in Aphabetical Order- Chapter 3', and 'Ear Perception Analysis : Scores in Ascending Order- Chapter 3.

Here is a sample of the table obtained:

Informant's Code	**Eval. 1**	**Eval. 2**	**Eval. 3**	**Eval. 4**	**Eval. 5**	**Average**
FAT01	3	2	3	3	3	2,80
FAT02	2	2	3	3	2	2,40
MAT1	2	3	2	3	2	2,40
MAT2	3	3	3	2	3	2,80

The left-hand column in the table gives the informant's code. The next five columns display the marks, from 4 to 1, given by each individual evaluator to the local informant whose code is on the left. The right-hand column gives the average obtained from adding the scores given by the five evaluators and dividing them by 5.

For example, FAT01, a female Algerian teacher, receives a mark of 3 from the first evaluator, 2 from the second evaluator, and 3 from each of the three other evaluators. The individual scores are then added: 3 + 2 + 3 + 3 + 3 equals 14. The average score for FAT01 is 14 divided

by 5, the number of evaluators. Her final score is 2,80. Now what does such a score mean? We decide to work out our own ranking scale, from 'insufficient' to 'satisfactory'.

The Ranking Scale

After listening several times to some recordings together, we decide to adopt the following three-class ranking scale. An average of two or below is to be considered insufficient, and the mark of a poor performance. An average of three or above is to be considered satisfactory, and the mark of a good performance. The remainder of the averages, namely from 2,20 to 2,80, shows room for improvement and the mark of a middling performance.

The scores are averaged first for the female, then for the male teaching population in Oran, and presented in ascending order, starting with those displaying the poorest performance according to our evaluation.

The FAT population

The following table presents FAT lowest scores.

Informant's Code	Eval. 1	Eval. 2	Eval. 3	Eval. 4	Eval. 5	Average
FAT03	1	2	1	2	2	1,60
FAT06	1	2	2	2	1	1,60
FAT04	2	2	1	1	3	1,80
FAT23	2	2	1	3	2	2,00

The above table shows the scores of the poor performers who scored two or les than two on average, according to the criteria set and the ranking scale agreed on.

It shows that 4 FAT informants out of 30, or 13,33 % of the Oran teaching population, exhibit insufficient competence in the area under study. From a sociological point of view, the findings indicate that 4 out of 25, or 16% of the Oran female teaching population, are considered poor performers by our ranking standards. The members of this group include one experienced[4] teacher and three fresh ones.

[4] We arbitrarily divided the teaching population into three classes. 'Fresh' teachers have less than five years' seniority. 'Midway' teachers have more than five but less than ten years' seniority. 'Experienced' teachers are those totalling more than ten years of teaching.

The next table concerns the second group that shows some room for improvement, that is those whose averages range between 2,2 and 2,8.

The following table presents FAT scores showing room for improvement.

Informant's Code	Eval. 1	Eval. 2	Eval. 3	Eval. 4	Eval. 5	Average
FAT02	2	2	3	3	2	2,40
FAT14	2	3	3	2	2	2,40
FAT24	2	3	3	3	2	2,60
FAT15	2	3	3	3	3	2,80
FAT17	2	3	3	3	3	2,80
FAT01	3	2	3	3	3	2,80

The above table shows the scores of the middling performers according to the criteria set and the ranking scale agreed on. It shows that 6 FAT out of 30, or 20 % of the Oran teaching population, demonstrate limited competence in the area under study. From a sociological point of view, the findings indicate that 6 FAT out of 25, or 24 % of the Oran female teaching population, have performances that leave room for improvement.

This population includes five fresh teachers and one experienced teacher.

The following table presents FAT scores showing acceptable performance.

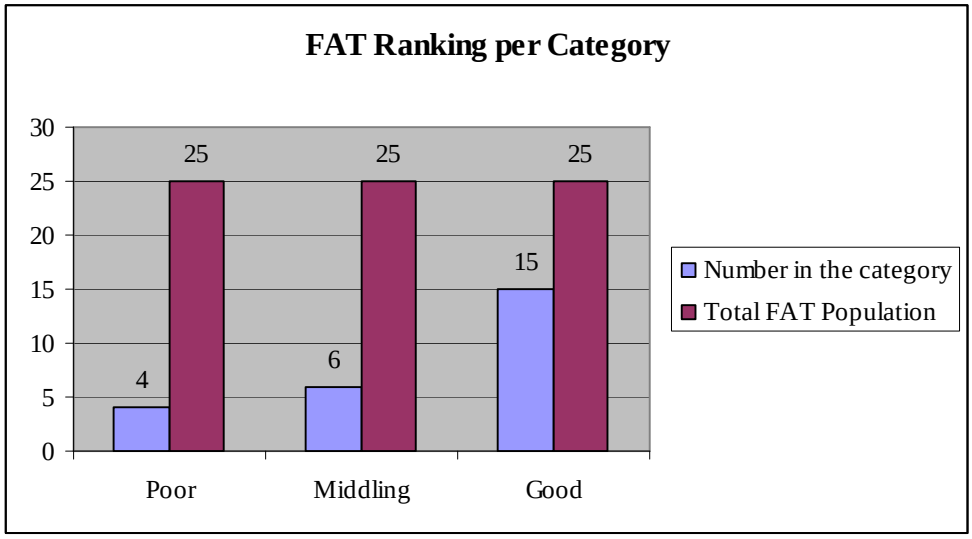
Informant's Code	Eval. 1	Eval. 2	Eval. 3	Eval. 4	Eval. 5	Average
FAT07	3	3	3	3	3	3,00
FAT12	3	3	2	4	3	3,00
FAT13	3	3	3	3	3	3,00
FAT16	3	4	2	3	3	3,00
FAT05	3	3	3	4	3	3,20
FAT11	3	3	3	3	4	3,20
FAT20	3	3	3	4	3	3,20

FAT21	3	3	3	4	3	3,20
FAT22	2	4	4	3	3	3,20
FAT09	3	4	4	3	3	3,40
FAT19	4	4	3	3	3	3,40
FAT08	3	3	4	4	4	3,60
FAT10	3	4	4	3	4	3,60
FAT18	4	4	4	4	4	4,00
FAT25	4	4	4	4	4	4,00

The above table shows the scores of the top performers according to the criteria set and the ranking scale agreed on. It shows that 15 FAT out of 30, representing 50 % of the Oran teaching population, demonstrate good competence in the area under study. From a sociological point of view, the findings indicate that 15 FAT out of 25, or 60 % of the Oran female teaching population, are good performers.

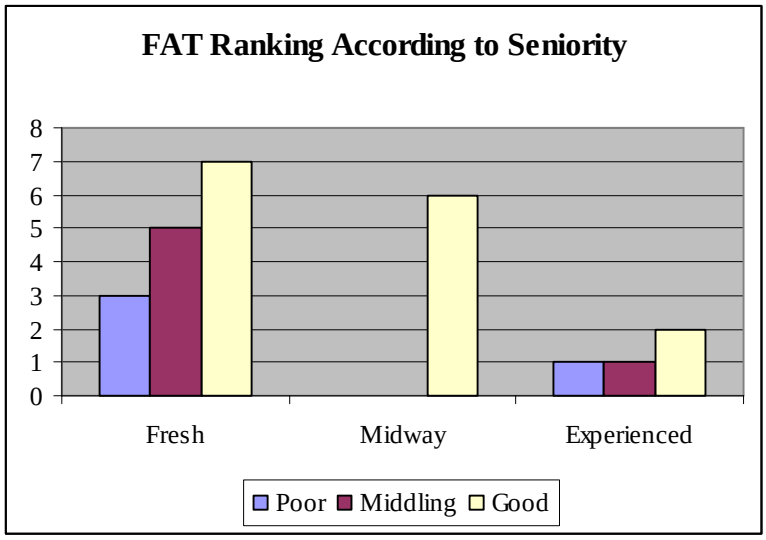
This population includes 7 ‘Fresh’, 6 ‘Midway’ and 2 ‘Experienced’ teachers.

The following graph summarises the situation. Within each of the three categories (Poor, Middling, Good), the number of performers is set against the total FAT population.



Graph 1: Ranking of FAT group within each category.

The distribution of FAT by order of seniority gives the following graph.



Graph 2: Ranking of Female Teachers by Order of Seniority

The female Midway generation appears to be more proficient than the other generations. They are all ranked as 'Good'. The other groups are distributed over all three categories

We now move to the MAT population and perform the same operations as for the female teachers of English in the Wilaya of Oran.

The MAT population

There are no poor performers as such. The rest of the population is distributed as follows. It is refreshing to note the absence of candidates for the category that scored two or below.

The following table presents MAT scores showing room for improvement.

Informant's Code	Eval. 1	Eval. 2	Eval. 3	Eval. 4	Eval. 5	Average
MAT1	2	3	2	3	2	2,40
MAT2	3	3	3	2	3	2,80

It shows that 2 MAT out of 30, or 6,66 % of the Oran teaching population, demonstrate limited competence in the area under study. From a sociological point of view, the findings indicate that 2 MAT out of 5, or 40 % of the Oran male teaching population, have performances that leave room for improvement. This class includes one 'Fresh' teacher and one 'Midway' teacher.

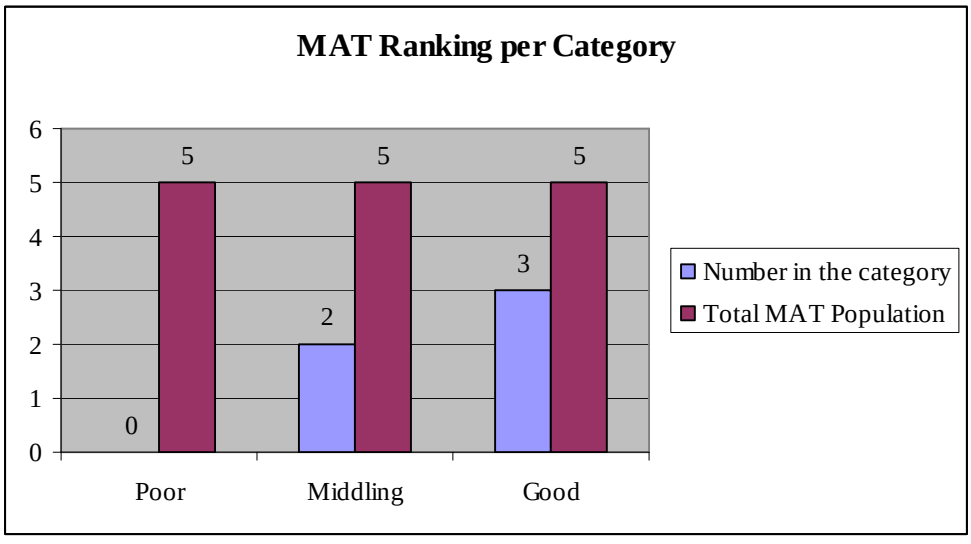
The second table presents MAT scores showing acceptable performance.

Informant's Code	Eval. 1	Eval. 2	Eval. 3	Eval. 4	Eval. 5	Average
MAT3	3	3	3	3	3	3,00
MAT4	4	4	4	4	4	4,00
MAT5	4	4	4	4	4	4,00

The above table shows that 3 MAT out of 30, representing 10 % of the Oran teaching population, demonstrate good competence in the area under study. From a sociological point of view, the findings indicate that 3 MAT out of 5, or 60 % of the Oran male teaching population, are good performers. This class includes one 'Fresh' and two 'Experienced' teachers.

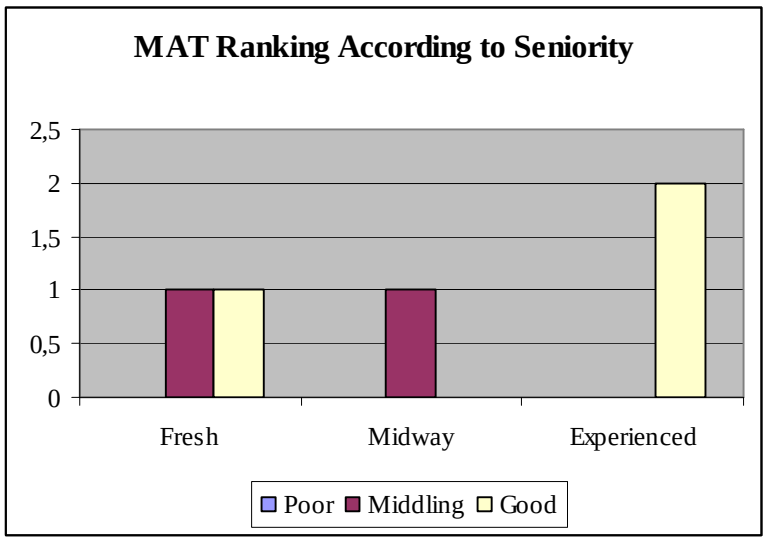
It is comforting to note that for both populations, the percentage of good performers by our Ear Perception Analysis standards reaches 60% of the population concerned, which is a reasonably good sign as to the state of rhythm in Oran schools. But we must keep in mind that this ranking concerns the mastery of the rhythm of English, to the exclusion of any other feature.

A bar graph shows the distribution of scores across the MAT population.



Graph 3: Ranking of MAT within each category.

The distribution of FAT by order of seniority gives the following graph.



Graph 4. Ranking of Male Teachers by Order of Seniority

We now move to the analysis of the most common mistakes detected by the Panel. .

Most Common Types of Mistakes

The most common mistakes include addition of an extra syllable; cluster reduction, when for example [ðɪs ɪz ðə kaʊ wɪð ðə krʌmpld hɔ:ŋ] becomes [ðɪs ɪz ðə kaʊ wɪð ðə krʌmld hɔ:ŋ]or even elision of a syllable; stressing a function word when requested to give a contrast and attitude free performance; unnecessary pauses or stops that make the flow of speech stilted and choppy; absence of vowel reduction when vowels in unstressed syllables become schwa or similar short lax vowel; little contrast between stressed and unstressed syllables. The list is by no means exhaustive but it includes the errors most widely distributed. Here are a few samples of such phonological processes.

Error Category: Adding Extra Syllables

Adding an Extra Syllable: Example 1

The extra syllable in the following example helps the speakers keep the rhythm. The last part of the utterance [ðə haʊs ðət dʒæk bɪlt] is made up of one unstressed syllable followed by one stressed syllable [ðə haʊs], then another unstressed syllable followed by another stressed syllable [ðət dʒæk], and suddenly there is only the stressed syllable [bɪlt]. The speakers make up for this absence by introducing their own unstressed syllable **(ə)** to keep the rhythm.

Informant(s):	FAT04, FAT23
Actual Realisation:	[ðɪs ɪz ðə haʊs ðət dʒæ**k(ə)b**ɪlt]
Realisation Targeted:	[ðɪs ɪz ðə haʊs ðət dʒæk bɪlt]

Adding an Extra Syllable: Example 2

In this example, the extra syllable in the form of a schwa helps the informant break the complex cluster of three syllables.

Informant:	FAT07
Actual Realisation:	[dʒɔ**n(ə)s**mɪθ]
Realisation Targeted:	[dʒɔn smɪθ]

Adding an Extra Syllable: Example 3

This appears to be an idiosyncratic feature.

Informant:	FAT22
Actual Realisation:	[æn left bɪɬə]
Realisation Targeted:	[æn left bɪɬ]

Adding an Extra Syllable: Example 4

This case is similar to gemination when a sound becomes double long. The following informants seem to produce the release of the final [t] sound before they produce the onset of the initial [t] of the second word. They insert what sounds like a pause or a schwa between the two [t]. We did not notice this phenomenon outside the present [t-t] context.

Informant(s):	FAT01, FAT11, FAT13, FAT22, FAT24
Actual Realisation:	[aɪ hæv ə lɔ**tə** tə duː] [hɪ bɔː**t̪ə** tuːkɑːz]

Realisation Targeted:	[aɪ hæv ə lɔt tə duː] [hɪ bɔːt tuːkɑːz]

Error Category: Elision of a Syllable

Elision of a Syllable: Example 1

The following example seems to be due to carelessness and 'sloppiness' more than anything else. It does not obey any rule whatsoever. It seems to be caused by the desire to speak quickly. Such elisions sometimes completely obscure the meaning of the message. A native speaker could not understand it at all even after hearing it several times, especially since the sentence was said in isolation. Only because we had the script could we guess the utterance.

Informant:	FAT06
Actual Realisation:	[bɪl ʃots lo taɪm] [aɪ stɑːd drɪŋkɪŋ tɪː rɪːsəntlɪ]
Realisation Targeted:	[bɪl ʃaʊts ɔːl ðə taɪm] [aɪ stɑːtɪd drɪŋkɪŋ tɪː rɪːsəntlɪ]

Elision of a Syllable: Example 2

This elision seems to obey the law of the least effort before a word that may be new to the informant. Two sounds have been elided: [p] and [d]. Like in the previous example, this elision also makes the meaning of the message unclear.

Informant:	FAT14
Actual Realisation:	[ðɪ ɪz ðə kaʊ wɪð ðə krʌml hɔːn]
Realisation Targeted:	[ðɪ ɪz ðə kaʊ wɪð ðə krʌmpld hɔːn]

Error Category: Stressing a Function Word

Stressing a Function Word: Example 1

Our instructions are very clear: No function word should carry a stress.

Technically, a function word can be stressed for emphasis, or contrast, in certain situations. For example '*I have told you*' could be said 'normally' as [aɪv **təʊld** ju] with one stressed

syllable, or it could be said as [aɪ**hæv tə**ʊ**ld** ju] with two stressed syllables for emphasis. The informant's realisation adds an extra RU by stressing a function word. We might have accepted a stress on the first syllable of 'never'.

Informant:	MAT2
Actual Realisation:	[aɪhæv nevə sɪ:n hə dɑ:nsɪŋ]
Realisation Targeted:	[aɪv nevə sɪ:n hə dɑ:nsɪŋ]

Stressing a Function Word: Example 2

Only teachers would think of stressing [**æt**] in the middle of a sentence, perhaps to correct a pupil who said "He is in work." It could be stressed at the end of a sentence, as for example in 'What are you looking at?' Neither case applies here.

Informant(s):	FAT21, FAT02, FAT07, FAT14, FAT16, FAT19, FAT23, MAT1, MAT3
Actual Realisation:	[hɪ ɪz æt wɜ:k]
Realisation Targeted:	[hɪ ɪz ət wɜ:k]

Stressing a Function Word: Example 3

The word 'some' can be stressed in certain contexts, but not here. The native speaker who hears such a sentence might be slightly confused. It expresses an attitude and we want our utterances to be neutral, as 'attitude-free' sentences as possible.

Informant(s):	FAT01, FAT04, FAT09, FAT14, FAT19, MAT3
Actual Realisation:	[wɪ lɪsənd tə sʌm mju:zɪk]
Realisation Targeted:	[wɪ lɪsənd tə səm mju:zɪk]

Stressing a Function Word: Example 4

Such stress can be correct to express contrast: 'I' and not somebody else. Many misunderstandings could arise from such misuse of the contrastive stress.

Informant:	MAT3
Actual Realisation:	[aɪ juːst tə pleɪ tenɪs ə lɔt]
Realisation Targeted:	[aju:st tə pleɪ tenɪs ə lɔt]

Error Category: Little Contrast between Stressed and Unstressed Syllables

This is the realisation by FAT03, but many other informants show little contrast between stressed and unstressed syllables in the utterances, forcing the listener to do much guesswork.

Informant(s):	FAT03, and many others.
Actual Realisation:	[aɪ fel ɪn lʌv wɪð ə bjuː tɪ ful gɜːl]
Realisation Targeted:	[aɪ fel ɪn lʌv wɪð ə bju:ṭɪfl gɜ:l]

Error Category: Absence of Vowel Reduction

Vowel reduction plays a key role in stress-based languages as Dauer (1983) and many others put it. Vowel reduction concerns primarily function words which have several possible realisations, and the weakest form is usually used in a neutral, 'attitude-free' situation as mentioned above. The example below concerns another form of non-implementation of vowel reduction. It concerns the reduced form of suffixes such as 'ing' in the present case.

Informant(s):	FAT01, and many others
Actual Realisation:	[aɪv nevə sɪːn hə dɑːnsɪːŋ]
Realisation Targeted:	[aɪv nevə sɪ:n hə dɑ:nsɪŋ]

Error Category: Unnecessary Pauses

Unnecessary Pauses: Example 1

Such pauses are easy to explain. They come as a welcome break in the middle of a long utterance. When they are associated with some pitch variation, such paralinguistic features tend to create a situation which is inappropriate when you give the title of a film as here.

Informant(s):	FAT02, FAT12, FAT16, FAT19, FAT20, FAT22, MAT1, MAT2
Actual Realisation:	[dʒɔn+smɪθ lʌvz+æn+waɪt] or [dʒɔn+smɪθ+lʌvz æn+waɪt]
Realisation Targeted:	[dʒɔn+smɪθ+lʌvz+æn+waɪt]

N.B. The + symbol joins two stretches of speech which are expected to be said or are actually said without any pause between them

Unnecessary Pauses: Example 2

In the next example, the pause could be accepted as an afterthought, giving a second bit of information, but then we would have two sense groups.

Informant(s):	FAT03, FAT14
Actual Realisation:	[dʒɔn+left+həʊm leɪt]
Realisation Targeted:	[dʒɔn+left+həʊm+leɪt]

N.B. The + symbol joins two stretches of speech which are expected to be said or are actually said without any pause between them

Error Category: Not Stressing a Normally Stressed Syllable

No lexical word can be left unstressed. There is no excuse for such a lapse because it can lead to a break in communication, and requires too much attention and effort on the part of the listener. It should be noted that this kind of mistake is not too common among our informants.

Informant(s):	FAT09, FAT16, FAT20, MAT1, MAT3
Actual Realisation:	[ɪts reɪnɪŋ tə hɑ:d]
Realisation Targeted:	[ɪts reɪnɪŋ tu: hɑ:d]

Comments

All the errors listed above do not carry the same weight. Some may be overlooked as they do not hamper communication. Absence of contrast between stressed and unstressed syllables, or absence of vowel reduction or pauses might be smiled off and attributed by the native listener to the speaker's foreign accent. Other types of mistakes could lead to ambiguity, such as for example stressing function words. Others still, such as the elision of syllables, or 'unstressing' syllables which are normally stressed could very well lead to a break in communication.

To sum up what has been said in this chapter devoted to Ear Perception Analysis, the next pages present in table and graph form the results reached so far first for the FAT, then for the MAT then a comparative table.

Statistical Presentation of Mistakes

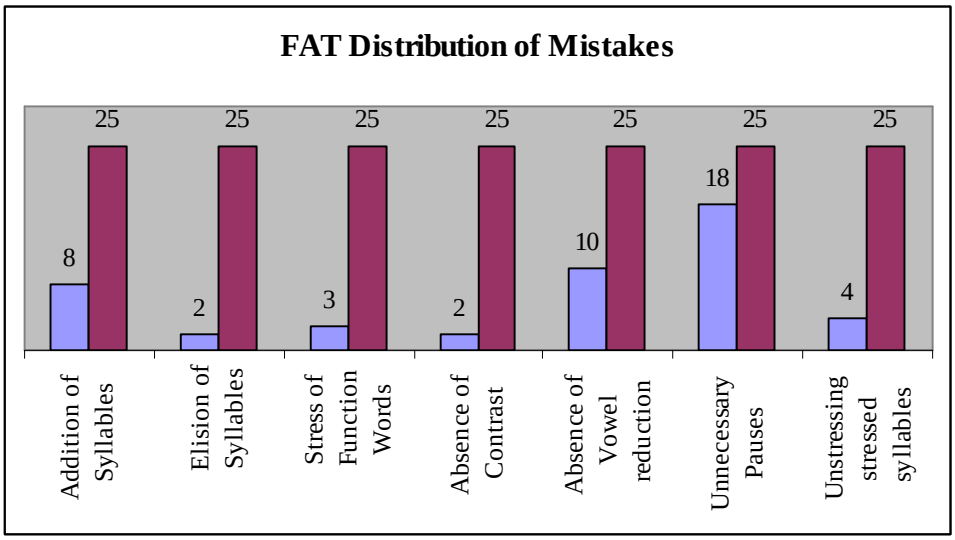
The following table presents the mistakes met during the EPA phase, first with the female teaching population and then with the male teaching population.

Female Teaching Population

Column 2 of the following table details the number of FAT informants who committed the mistakes listed in the left-hand column. The right-hand column gives the percentage out of the total FAT population.

Types of Mistakes	FAT	Total FAT Population	Percentage
Addition of Syllables	8	25	32 %
Elision of Syllables	2	25	8 %
Stress of Function Words	3	25	12 %
Absence of Contrast	2	25	8 %
Absence of Vowel Reduction	10	25	40 %
Unnecessary Pauses	18	25	72 %
Unstressing Stressed Syllables	4	25	16 %

The graph below gives a clear description of the situation.



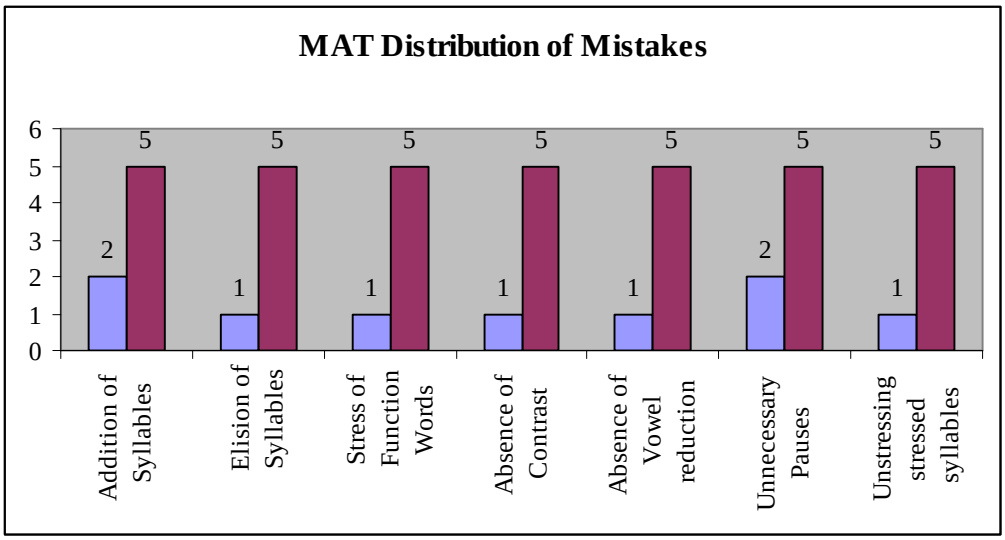
Graph 5: Distribution of the seven types of mistakes among FAT

Male Teaching Population

Column 2 of the following table details the number of MAT informants who made the mistakes listed in the left-hand column. The right-hand column gives the percentage out of the total MAT population.

Types of Mistakes	MAT	Total MAT Population	Percentage
Addition of Syllables	2	5	40 %
Elision of Syllables	1	5	20 %
Stress of Function Words	1	5	20 %
Absence of Contrast	1	5	20 %
Absence of Vowel Reduction	1	5	20 %
Unnecessary Pauses	2	5	40 %
Unstressing Stressed Syllables	1	5	20 %

The graph gives the same figures in a more visual form.



Graph 6: Distribution of the seven types of mistakes among MAT

Statistical Comparison

It must be clearly stated that the figures indicated in the various tables concern the number (or percentage) of the given population who made the mistake listed in the left-hand column, and

not the number of times a given mistake has been spotted. The table on the next page presents the two groups' percentages side by side to make comparison easier.

Comparative Table

This table presents the performances of the two local groups of informants in a statistical form.

Types of Mistakes	**Percentage FAT**	**Percentage MAT**
Addition of Syllables	32 %	40 %
Elision of Syllables	8 %	20 %
Stress of Function Words	12 %	20 %
Absence of Contrast	8 %	20 %
Absence of Vowel Reduction	40 %	20 %
Unnecessary Pauses	72 %	40 %
Unstressing Stressed Syllables	16 %	20 %

We can make these observations.

First, the addition of syllables to keep the rhythm, the unstressing of stressed syllables and the elision of syllables seem to be equally shared by the two groups, as well as the unnecessary stressing of function words. Pauses and the absence of vowel reduction on the other hand seem to be more popular with FAT, but they are better than MAT as concerns the contrast between stressed and unstressed syllables.

Conclusion

EPA allows us to get a fair picture of the state of the rhythm of English in Oran schools. The errors detected have been categorised. There is also tentative sociolinguistic distribution based on the questionnaire that the informants filled in at the beginning of the research.

The next chapter is devoted to the study of stress-timing through instrumental investigation. Will it yield similar or different results?

Chapter Four: Instrumental Analysis Geared to Stress-Timing

Introduction

This chapter is devoted to the study of rhythm in its manifestation as stress-timing. This is to be achieved through three operations. The first one compares the durations[5] of each of the five sets as realised by the local groups of informants with those of the native speakers. The next operation concerns the examination of four selected utterances which have the same number of syllables, but a different number of RUs. The third and final operation calculates the durations of stressed and unstressed syllables in eight selected utterances.

Before going into the heart of the matter, it is necessary to note three important facts concerning the norm, the increment rate and standard deviation.

The Norm

The first is a reminder of what is called the norm throughout this research. It is the mean of the realisations by the native speakers. This is made clear in the following table:

Informant	Utterance Duration
NAS1	0,358
NAS2	0,417
NAS3	0,289
NAS4	0,350
Total Duration	**1,414**
Mean Utterance Duration or Norm	**0,354**

The numbers under Utterance Duration refer to the duration of an utterance. In this case, it happens to be the first utterance from the first set, namely 'John'. It means that NAS1 pronounced the utterance in 358 milliseconds or 0,358, as measured by WASP. The duration is indicated in seconds throughout this research. The next line gives the total duration of the four utterances. The mean duration of the utterance is obtained by adding the individual durations for each of the four utterances (0,358 + 0,417 + 0,289 + 0,350= 1,414) and dividing

[5] In the calculations throughout this research, the words 'Time(s)' or 'Timing(s)' or 'Duration(s)' are used interchangeably.

the total obtained by the number of informants, four in the example: 1,414 / 4 = 0,354. So 0,354 is the norm for the utterance concerned.

The Increment Rate

The second point that needs clarifying is the increment rate, whose working definition is also given page IV. Some people are naturally fast speakers, while others are naturally rather slow speakers.

For example, let us imagine Informant 1 saying three utterances in 4, 8 and 10 seconds respectively, and Informant 2, who speaks more quickly, saying the same three utterances in 2, 4 and 5 seconds respectively. The measurements of the actual durations of the utterances or their means indicate huge differences between the realisations by the two informants: 7,333 for the first, and 3,667 for the second, as shown in the following table. These differences are due to individual rates of delivery which must be accounted for.

	Utterance Durations			Mean Duration
Informant 1	4	8	10	7,333
Informant 2	2	4	5	3,667

In order to account for the critical question of individual delivery rate of both native and local informants, our calculations take into consideration when necessary the increment rate from one utterance to another, rather than the actual durations of the utterances.

We obtain the increment rate by dividing the duration of the second utterance by the duration of the first, that of the third by the second, of the fourth by the third, etc. In the present case, concerning Informant 1, we divide 8 by 4 (we get 2), and then 10 by 8 (we get 1,25). For the second informant, we divide 4 by 2 (we get 2), and then 5 by 4 (we get 1,25) as shown below.

	Increment Rate		Mean Increment
Increment Informant 1	**2**	**1,25**	**1,625**
Increment Informant 2	**2**	**1,25**	**1,625**

If we now look at the increment rates, the percentage by which the durations increase, the figures are exactly the same for the two informants: 2 and 1,25 and of course they yield the

same Mean, 1,625. In other words, the utterances increase at the same rate for the two informants although they have different rates of delivery.

The Standard Deviation

The third point deals with standard deviation. It is a complex operation which calculates how the data, in our case utterance or rhyme durations, is tightly clustered or widely spread apart around the mean. It thus reveals how homogeneous or heterogeneous a group is. The closer SD is to zero, the more homogeneous the group, the farther SD is from zero, the more spread apart the data from the mean and therefore the more heterogeneous the group. Let us imagine 3 classes A, B, and C with six learners each. They get the following marks in their exam.

	Learner 1	Learner 2	Learner 3	Learner 4	Learner 5	Learner 6
Class A	12	12	12	12	12	12
Class B	10	10	11	11	12	12
Class C	6	8	10	12	14	16

It is clear from the table that Class A is the most homogeneous, and Class C the least homogeneous. This is exactly what the standard deviation shows us. A complex operation gives the SD for each class as follows: Class A has an SD of 0,000 (zero); Class B has an SD of 0,894 and Class C has an SD of 3,741. What should be remembered is that the closer SD is to zero, the more homogeneous the group is. We frequently refer to SD to see which of FAT or Mat is more homogeneous as a group.

In our research, we make use of the Microsoft Excel 2003 '*ecartype*' function to calculate the various standard deviations we deem useful or necessary.

We can now start our analysis with the first operation.

Operation One: Mean Durations and Increment Rates of Sets

The objective of this operation is to calculate the mean set durations by each group of informants, and see how the durations increase from one set to another as the number of RUs increases. We then calculate the increments for each set and for each group of informants to bypass the question of individual rates of delivery, and finally we calculate the standard deviations for the three groups of informants to see how homogeneous or heterogeneous the groups are.

Step 1: Sets Utterance Durations

Using the Rough Data in the Calculations Booklet, the mean set durations are obtained by adding the individual timings of each performer within a given group and dividing the total obtained by the number of informants of the group.

As an example, here is how the mean durations of Set 2 are calculated for the MAT group.

The rough data appears in the *Calculations Booklet* for Set Two: Utterance Durations.

Set 2	**John Smith.**	**John** and **Ann**.	I **like** it **rare**.	She's **ta**king a **bath**	She's **ha**ving her **break**fast.	We **lis**tened to some **mu**sic.
MAT1	0,751	0,884	1,065	1,149	1,431	1,438
MAT2	0,742	0,562	0,743	1,082	1,228	1,120
MAT3	0,769	1,071	1,216	1,227	1,517	1,530
MAT4	0,868	0,763	0,875	1,183	1,293	1,174
MAT5	0,821	0,641	0,813	1,015	1,193	1,080

The next step is to calculate the Mean Durations for each utterance.

Set 2	John Smith.	John and Ann.	I like it rare.	She's taking a bath	She's having her breakfast.	We listened to some music.
Mean Utterance Duration	0,790	0,784	0,942	1,131	1,332	1,268

We have now the Mean Durations for each of the six utterances within the set. The first utterance in Set 2, '*John Smith*' is said in 0,790 second by MAT as a group.

We need now to calculate the Mean of Set 2 as a whole for this group. We obtain it by adding the six Mean Utterance Durations displayed on the table and dividing them by the number of Informants in the group, that is five.

The following table is obtained:

	John Smith.	John and Ann.	I like it rare.	She's taking a bath	She's having her breakfast.	We listened to some music.
Mean Utterance Duration	0,790	0,784	0,942	1,131	1,332	1,268
Mean Set Duration	1,041					

The Mean Set Duration is therefore 1,041 for Set 2 for the MAT group.

Step 2: Sets Increment Durations

It is calculated as mentioned above using the same data from Appendix 1: Set 2: Rough Data to use the same example as Step 1. The Set Increment Duration is calculated from the Mean Utterance Duration of the Set. For Set 2, the MAT Mean Utterance Duration arrived at in Step 1 above.

MAT Set 2	John Smith.	John and Ann.	I like it rare.	She's taking a bath	She's having her breakfast.	We listened to some music.
Mean Utterance Duration	0,790	0,784	0,942	1,131	1,332	1,268

From this table, we then calculate the individual Increment Rates by, as explained earlier, dividing each utterance by the one preceding it, which is impossible for the first column considered as the reference: 0,790 cannot be divided since there is no data preceding it. We refer to it as 1,000 or the unit of reference. We then divide 0,784 by 0,790 and we get 0,992 which is the increment rate for the second utterance. If the increment is 1, it means that the two utterances have the same duration. If it is less than 1, it means it is shorter than the utterance preceding it, as appears to be the case here for Utterance '*John and Ann*' and for Utterance '*We listened to some music*'. In all the other cases, the increment is more than one, which implies that the utterance concerned is longer than the one preceding it. Of course this is visible simply by looking at the duration table above. But referring to the increment gives us a percentage, or rate, by which an utterance increases or decreases in relation to another,

disregarding the actual durations and thus bypassing idiosyncratic differences in how fast or how slowly an informant speaks.

Once we have those individual increments, we add them up and divide them by the number of informants. We get the following table:

MAT Set 2	John Smith.	John and Ann.	I like it rare.	She's taking a bath	She's having her breakfast.	We listened to some music.
Mean Utterance Duration	0,790	0,784	0,942	1,131	1,332	1,268
Mean Utterance Increment		0,992	1,202	1,200	1,178	0,952
Mean Set Increment	1,087					

Step 3: Standard Deviation

First we calculate the means of each informant by adding their individual duration for each of the six utterances and we divide the total obtained by the number of informants, in this case five. We obtain the individual means which appear on the right-hand column. Following the method explained in the opening of this chapter, the standard deviation is then calculated. We obtain 0,131, the standard deviation for MAT Set 2.

Set 2	**John Smith.**	**John** and **Ann**.	I **like** it **rare**.	She's **ta**king a **bath**	She's **ha**ving her **break**fast.	We **lis**tened to some **mu**sic.	Mean Duration Per Informant
MAT1	0,751	0,884	1,065	1,149	1,431	1,438	1,120
MAT2	0,742	0,562	0,743	1,082	1,228	1,120	0,913
MAT3	0,769	1,071	1,216	1,227	1,517	1,530	1,222
MAT4	0,868	0,763	0,875	1,183	1,293	1,174	1,026

MAT5	0,821	0,641	0,813	1,015	1,193	1,080	0,927
Standard Deviation							**0,131**

The figures on the right-hand column represent the Means of each MAT informant for Set 2. SD 0,131 represents the standard deviation of the Set.

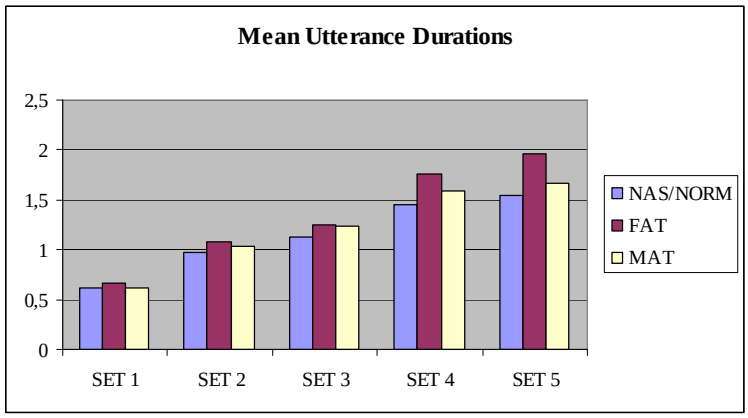
The different procedures being explained in detail, we can now move to the actual operations. In other words, we now have to go through the same three steps for each of the five sets of the corpus and with each of the three groups of informants.

The findings appear in three different tables, one dealing with the mean durations of each set for each of the group of informants. The second shows the mean increments for each set and for each group of informant. The third displays the standard deviations regarding durations of utterances for each of the three groups of informants.

Mean Durations of Each Set for Each Group

		Set 1	Set 2	Set 3	Set 4	Set 5
Mean Utterance Duration	NAS/NORM	0,616	0,969	1,121	1,457	1,543
	FAT	0,658	1,076	1,251	1,756	1,953
	MAT	0,625	1,041	1,239	1,597	1,664

It can appear more visually in the following graph.



Graph 7: Mean Utterance Durations of Five Sets

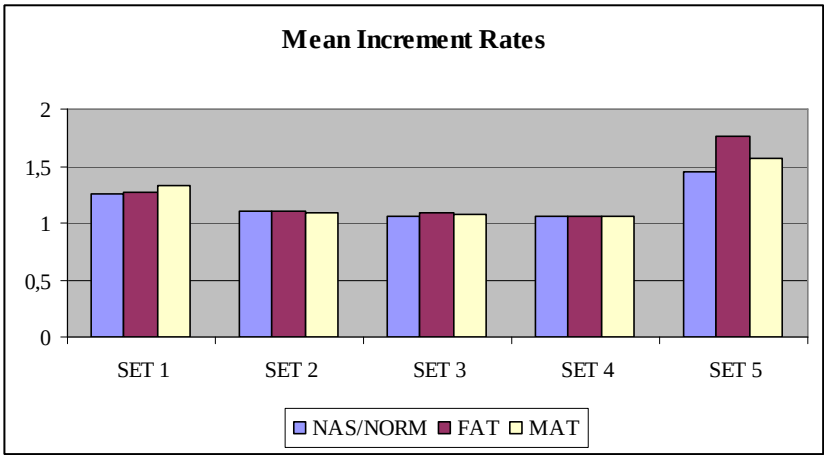
Comments

As explained repeatedly, the Means of the NAS constitute the Norms to be targeted by the other two groups. The first observation that can be made is that NAS speakers, whose durations appear on the first line of the table, realise the utterances more quickly than either group for all the sets. It is quite visible in Graph 7 above. It can also be seen that MAT speakers are closer to the norm than FAT speakers throughout the five sets. Another important observation is that the longer the utterance, the greater the gap with the Norm, especially on the part of the FAT group.

Mean Increments of Each Set for Each Group

		SET 1	SET 2	SET 3	SET 4	SET 5
MEAN INCREMENT RATES	NAS/NORM	1,252	1,102	1,067	1,067	1,446
	FAT	1,267	1,109	1,092	1,064	1,758
	MAT	1,331	1,087	1,078	1,057	1,574

A graph shows the present data more visually below.



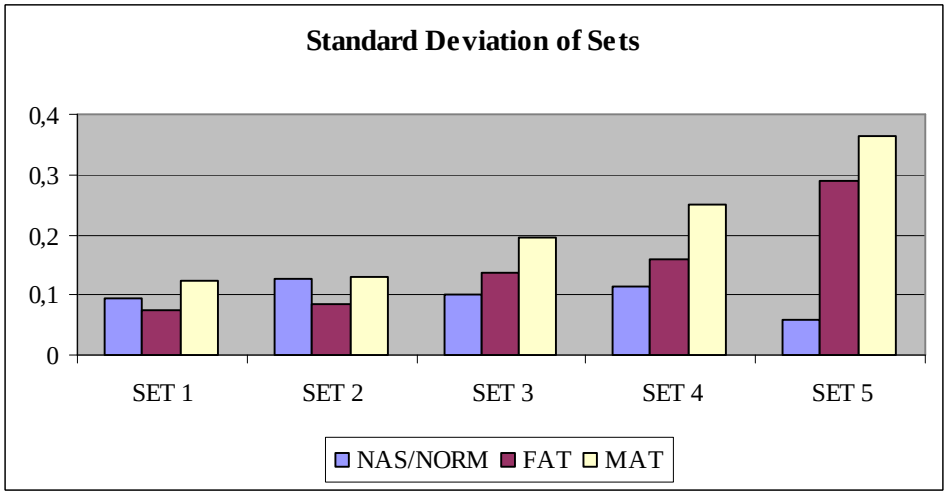
Graph 8: Mean Increment Rates for the Sets

Comments

From Set 2 to Set 4, the mean increment rate revolves around 1, which is an indication of a regular increment that can easily be perceived as isochronous by the human ear. Set 5 has a greater increment rate, due principally to pauses. The closeness of the MAT speakers to the norm is confirmed, except for Set 1.

Standard Deviation for Each Group

		SET 1	SET 2	SET 3	SET 4	SET 5
DURATION	NAS/NORM	0,095	0,127	0,102	0,114	0,058
STANDARD	FAT	0,076	0,086	0,135	0,158	0,291
DEVIATION	MAT	0,125	0,131	0,194	0,251	0,365



Graph 9: Sets Standard Deviation

Comments

The NAS group is the most homogeneous group, followed by the FAT group, and then the MAT group. Another observation is that the more RUs an utterance contains, the more spread apart are the realisations of the non native informants, especially the MAT group.

The data and calculations used for this operation appear in the *Calculations Booklet* under the headings *NAS / FAT / MAT Mean Durations and Increment Rates Chapter Four Operation One.*

Operation Two: Analysis of Selected 4 Syllable Utterances

The utterances selected have the same number of syllables, 4 in all. But each time, an RU replaces an unstressed syllable. In this operation we aim to compare the durations of realisations 1_4, 2_4, 3_4 and 4_4 on the part of each group of informants. Then we study vowel reduction, and examine how duration and increment behave when a new RU is added, in replacement of an unstressed syllable.

The utterances are:

Code	Utterance	Number of Stressed Syllables	Number of Unstressed Syllables	Total Number of Syllables
1_4	*He is at work*	One	Three	Four
2_4	*I like it rare*	Two	Two	Four
3_4	*He bought two cars.*	Three	One	Four
4_4	*John left home late*	Four	None	Four

Durations, Increment and Standard Deviation

Following the procedures detailed in the opening of this chapter, we calculate the mean durations per utterance and the overall mean for each group of informants. We then calculate the increment for each of the realisations, and finally we calculate the related standard deviations.

We get the following table.

		1_4	2_4	3_4	4_4	Overall Means
Mean Duration	NAS	0,769	0,861	1,057	1,137	0,956
	FAT	0,800	0,938	1,216	1,369	1,081
	MAT	0,768	0,942	1,248	1,271	1,057

Mean Increment	NAS		1,121	1,248	1,080	1,055
	FAT		1,196	1,305	1,139	1,110
	MAT		1,254	1,340	1,017	1,095

Comments

As expected, but it is nonetheless very comforting, duration increases whenever a stressed syllable replaces an unstressed one.

The standard deviation table below confirms what has been said earlier for all the operations. The NAS group is the most homogeneous, followed by the FAT group, and the MAT group the least.

		1_4	2_4	3_4	4_4	Overall Means
Standard Deviation	NAS	0,139	0,177	0,100	0,068	0,121
	FAT	0,163	0,133	0,158	0,183	0,159
	MAT	0,219	0,194	0,179	0,226	0,205

Operation Three: Duration of Stressed and Unstressed Syllables

Aware as we may be of the daunting task of defining a syllable's limits (Roach 1982 amongst others), we decide however to launch an experiment to time stressed syllables. We justify our choice on two grounds. First because we have come to the conclusion that analysing stressed and unstressed syllables could yield important results in terms of stress-timing and vowel reduction; and secondly because we can expect to reduce errors due to syllable boundaries when the same technique is applied throughout, using the same soft and hardware, making similar measurements by the same evaluator.

For this operation, eight utterances have been selected going from 1 RU to 4 RUs, and from 2 to 6 unstressed syllables. The selected utterances appear to be indicative of normal everyday general conversation. They are:

She's a**lone**.	He is at **work**.
I **like** it **rare**.	She's taking a **bath.**
I **have** a **lot** to **do**.	I've **ne**ver **seen** her **dan**cing.
I **used** to **play ten**nis a **lot.**	I **fell** in **love** with a **beau**tiful **girl**.

The objective is to compare the durations of stressed and unstressed syllables in semi-connected speech, and to assess how local teachers compare with the native 'norm setters' in terms of length of stressed syllables and shortness of unstressed syllables.

The calculations are provided in the *Calculations Booklet* and appear in seven pages. They include the duration of the utterance as a whole, the duration of the stressed syllable or syllables of the utterance, and the latter is or are subtracted from the duration of the utterance as a whole to give the duration of the unstressed syllable or syllables.

The way the calculations have been made, the pauses are included in the duration of the unstressed syllables. Had we counted the durations of the unstressed syllables instead of the stressed ones, added them up, and subtracted them from the duration of the utterances, the results would have been different.

First Pair

She's alone 1RU_3Syl		
Group	RUs	Unstressed
NAS	0,348	0,351
FAT	0,300	0,410
MAT	0,353	0,341

He is at work 1RU_4Syl	
RUs	Unstressed
0,362	0,407
0,372	0,428
0,427	0,340

Comments

Except for the MAT group, the stressed syllables are shorter than the unstressed syllables. This is due partly to the 'She' or the 'He' in initial position which have received more than their share time-wise. Another possible explanation is the fact that the utterance is said in isolation, and not part of conversational connected speech. The differences are also due most probably to the intrinsic quality of the vowels. Lehiste (1971, p. 70) states that "…there appears to be a physiological reason for the fact that high vowels are associated with a relatively high fundamental frequency." He explains that when the tongue is raised towards the hard palate to produce a high vowel, and as a result, there is a stretching of the laryngeal muscles, the vocal cords become tenser, which makes them vibrate more quickly.

Second Pair

I **like** it **rare** 2RU_4Syl.		
Group	RUs	Unstressed
NAS	0,526	0,335
FAT	0,548	0,390
MAT	0,575	0,367

She's **tak**ing a **bath**. 2RU_5Syl	
RUs	Unstressed
0,644	0,434
0,676	0,485
0,689	0,442

Comments

The results are refreshingly orthodox. The two stressed syllables are longer than the two or three unstressed syllables of Utterances 2RU_4Syl and 2RU_5Syl respectively.

Third Pair

I **have** a **lot** to **do** 3RU_6Syl		
Group	RUs	Unstressed
NAS	0,586	0,376
FAT	0,660	0,439
MAT	0,671	0,445

I've never seen her dancing 3RU_7Syl	
RUs	Unstressed
0,551	0,749
0,578	0,950
0,592	0,890

Comments

Utterance 3RU_6Syl behaves as would be expected, i.e. the total duration of the three stressed syllables is longer than the total duration of the three unstressed syllables. This 'normal' behaviour is perhaps caused by the repeated occurrence of a foot made up of 1 unstressed syllable followed by a stressed syllable.

On the other hand, in Utterance 3RU_7Syl, the majority of informants, natives included, pronounce the [aɪ] of [aɪv nevə sɪ:n hə dɑ:nsɪŋ] with more prominence than we anticipated, thus making the unstressed syllable [a ɪ v] rather long. Other possible explanations include the intrinsic quality of the high vowel [ɪ]in [dɑ:nsɪŋ] , and giving the [hə]in [aɪv nevə sɪ:n hə dɑ:nsɪŋ] too much prominence.

Fourth Pair

I used to play tennis a lot. 4RU_8Syl		
Group	RUs	Unstressed
NAS	0,705	0,628
FAT	0,951	0,733
MAT	0,958	0,807

I fell in love with a beautiful girl. 4RU_10Syl	
RUs	Unstressed
0,842	0,817
0,914	1,048
0,845	1,001

Comments

These two utterances behave as expected for the NAS group. For the non native groups, Utterance 4RU_8Syl appears to be normal, i.e. as expected, the stressed syllables are longer than the unstressed ones. The second utterance does not and that is due most probably to the

pauses and perhaps also to 'unstressing' stressed syllables as 16% of the FAT group and 20% of the MAT group did.

Conclusion

After the three operations in this chapter, we can come to the conclusion that stress-timing is realised by all the informants and above all measurable. It is clear from the second operation that duration increases whenever a stressed syllable replaces an unstressed, although the number of syllables remains unchanged. Stress-timing and vowel reduction go hand in hand. This is evidenced by the results of operation 1 in this chapter. For example, in operation 1, time is multiplied by roughly 2, 3 or 4 when new stressed syllables are added for the MAT group. It goes from 0,319 to 0,790 to 0,950 to 1,271 when a new RU is added. When, on the other hand, seven unstressed syllables are added as e.g. in Set 4, the time moves only from 1,271 to 1,935. It is multiplied by just over 1,5 or 1,522 to be precise.

Our informants are capable of realising stress-timing. Whether this stress-timing is isochronous or not is the object of the next chapter. Four operations are launched to examine the question. In chapter 5, we focus more extensively on the rhyme in the hope of exploring the attractive notion of isochrony. We go as far as putting the rhyme to the test of a musical metronome. We concentrate on the rhyme, but not just. The first utterances from the five sets are examined to see if some form of isochrony emerges when dealing with utterances made up of one, then two, then three, then four, then five stressed monosyllabic words. There is also a mixed operation involving two 4RU_7Syl sentences, one from the utterances and one from the rhyme.

Chapter Five: Instrumental Analysis Related to Isochrony

Introduction

Isochrony is at best debatable, a moot point. As stated in Chapter One, some researchers have regarded it as sacred, others have refuted it completely, a greater number have a midway position saying isochrony is perceived even if it has hardly any physical acoustic correlates, others still distinguish between 'strict' and 'weak' isochrony and see the former as coincidental and rare in everyday speech. Obviously, no one in their right mind would expect true isochrony to exist outside the realm of music. But the notion of isochrony, in the sense of certain 'cannon ball' stressed syllables thundering at intervals perceived as equal has survived.

This chapter is devoted to the study and analysis of isochrony through four different operations. The first operation tries to assess what happens when the utterances under study contain no unstressed syllables. As all the words in these utterances are monosyllabic words, we expect to find some form of isochrony, just like in counting for example, following Abercrombie's second hypothesis. The second operation focuses on an old British Rhyme, which normally should display regular isochronous beats. The third operation compares a selected utterance and Part 1 of the Rhyme which both have the same number of stressed and unstressed syllables. The final operation puts the informants' realisations of the Rhyme, perceived as exhibiting isochrony, to the test of a musical metronome.

Operation One: Analysing Stressed Syllable Utterances Only

In this operation, we analyse the first utterance from each set. We concentrate on those utterances because they contain only stressed syllables, which means that our corpus will include a total of 5 utterances, namely 1RU_1Syl, 2RU_2Syl, 3RU_3Syl, 4RU_4Syl and 5RU_5Syl.

The objective is to see if there are any signs of isochrony at least in some parts of the Rhyme. To that end, we calculate the mean utterance duration and standard deviation of each utterance for each group of speakers, as well as the overall means and compare the performances of the local teachers with the norms set by the native speakers. After that, we compare the increment rate and standard deviation of each utterance from each set on the part of each group of performers. Last but not least, we calculate the mean duration and the standard deviation of a stressed syllable or Rhythm Unit for each group of speakers, and weight the performances of the local teachers against those of the native speakers.

The procedures detailed in the opening of the previous chapter are applied to all the calculations included in this chapter.

Step One: Mean Utterance Durations

The Mean is obtained by adding the various realisations by each informant from a given group and dividing the total obtained by the number of informants in that group.

Here is an example of how a mean is calculated. The numbers in column 1_1 represent the durations of the utterances as realised by informants NAS1 to NAS5. The numbers are added up and divided by the number of informants. The result is 0,354. All the data and the calculation results (individual and group means, standard deviations, and increment rates) for this operation are available in the *Calculations Booklet* under two headings, one related to durations and the second to increment rates.

	Utterance Durations				
	1_1	2_2	3_3	4_4	5_5
NAS1	0,358	0,683	0,721	1,056	1,618
NAS2	0,417	0,767	0,984	1,153	1,547
NAS3	0,289	0,581	1,072	1,121	1,478
NAS4	0,350	0,735	0,951	1,219	1,528
MEAN	**0,354**	**0,692**	**0,932**	**1,137**	**1,543**

The get the overall mean, we add up the individual means (0,354 through 1,543) and divide the sum by 5, the number of items. The result is 0,931, as is shown on the next table.

Applied to the three groups and to the five utterances, we get the following table. It should normally be read in conjunction with the table which displays the increment rates.

Mean Utterance Durations and Overall Means

		1_1	**2_2**	**3_3**	**4_4**	**5_5**	**Overall Means**
Mean Durations	NAS/Norm	0,354	0,692	0,932	1,137	1,543	0,931
	FAT	0,375	0,803	0,937	1,369	1,953	1,087
	MAT	0,319	0,790	0,950	1,271	1,664	0,999

Increment Rates per Group of Informants

	1_1	**2_2**	**3_3**	**4_4**	**5_5**
NAS		1,964	1,369	1,241	1,361
FAT		2,291	1,174	1,473	1,443
MAT		2,606	1,201	1,352	1,304

Comments:

The first notable fact is that on the whole, MAT are closer to NAS than FAT, and the gap between FAT and NAS increases with 4_4 and 5_5, that is when stressed syllables are added. This is perhaps due to the numerous pauses noticed in the realisations by the FAT group. As indicated in the tables summarising the types of mistakes in Chapter three, 72% of FAT made unnecessary pauses as against only 40% of MAT.

A second important remark concerns the huge increase from 1_1 to 2_2, which has almost doubled for NAS (from 0,354 to 0,692, a rate of increase of 196 %) more than doubled for FAT (from 0,375 to 0,803, a rate of increase of 229 %) and almost trebled for MAT (from 0,319 to 0,790, a rate of increase of 260 %). This may be due to our measuring of the duration of voiceless dental fricative [θ] at the end of the word [smɪθ] as it is difficult to see exactly where the sound [θ] ends because of the charcoal smudges which appear on the spectrogram.

Standard Deviation of Mean Durations

		1_1	2_2	3_3	4_4	5_5	**Overall Means**
Standard Deviation of Mean Durations	**NAS**	0,052	0,081	0,150	0,068	0,058	**0,082**
	FAT	0,121	0,101	0,139	0,183	0,291	**0,167**
	MAT	0,072	0,053	0,164	0,226	0,365	**0,176**

Comments

Here again, if we look at the overall means, the FAT group is slightly more homogeneous than the MAT group, although far less so than the NAS group.

Step Two: Stressed Syllables Mean Duration

All the syllables in the utterances under study are stressed monosyllabic words. They are fifteen in number, that is 1 (of 1_1) + 2 (of 2_2) + 3 (of 3_3) + 4 (of 4_4) + 5 (of 5_5). First we calculate the group mean duration, based on the individual mean durations for the first utterance. NAS1 says it 0,358, NAS2 in 0,417, NAS3 in 0,289, and NAS4 in 0,350.

These timings are added and divided by 4, the number of informants of the group to get the mean group for Utterance 1_1. We get 0,354. We make the same calculations for the other utterances of the corpus concerned, and we get 0,692 for 2_2, 0,932 for 3_3, 1,137 for 4_4, and 1,543 for 5_5.

The results obtained are added up and then divided by 15, the number of RUs in the corpus and we get 0,310. It is the mean duration of one stressed syllable for the NAS group.

We follow the same steps described above twenty-five times for the FAT group, and five times for the MAT group. We come up with the following table:

Stressed Syllable Mean Duration	NAS	0,310
	FAT	0,362
	MAT	0,333

Following the procedure described in Chapter 3, we calculate the standard deviations related to the duration of a stressed syllable for the three groups of informants.

And the standard deviation is:

Stressed Syllable Standard Deviation	NAS	0,013
	FAT	0,037
	MAT	0,049

Comments

The same observations can be made once again. The MAT group is closer to the norm than the FAT group, and the FAT group is more homogeneous than the MAT group, although less so than the NAS group. One important point worth investigating further concerns the

perception of isochrony in the NAS realisations of 3_3 and 4_4 utterances. The mean duration increases by 0,240 second (0,932 – 0,692) from 2_2 to 3_3 and by 0,205 second (1,137 – 0,932) from 3_3 to 4_4. This means that there is a very small difference (35 milliseconds) between these utterances. This calls for two important remarks. First, 35 milliseconds are impossible to perceive by the human ear, and we can speak of isochrony here. Secondly, such utterances of 2 RUs, 3 RUs or 4RUs appear to be the most frequent and appear to be the most widely distributed in everyday conversational speech as we found during our search for the corpus.

In conclusion, instrumental analysis in this operation reveals the presence of a fairly strict form of isochrony for the NAS group for 2RU, 3RU and 4RU utterances. For the MAT and FAT groups, isochrony is perceived to a great extent, but not supported by the measuring tool. Our next object is the rhyme, which should display a stronger form of isochrony.

Operation Two: Analysis of Rhyme

The corpus is made up of the first five parts of an old British rhyme '*This is the house that Jack built*'. Part 1 of the rhyme has seven syllables, four of which are stressed, symbolised as 4RU_7Syl. Part 2 of the rhyme has sixteen syllables, eight of which are stressed, symbolised as 8RU_16Syl. Part 3 of the rhyme has twenty syllables, ten of which are stressed, symbolised as 10RU_20Syl. Part 4 of the rhyme has twenty-five syllables, twelve of which are stressed, symbolised as 12RU_25Syl. Finally, part 5 of the rhyme has thirty-four syllables, sixteen of which are stressed, symbolised as 16RU_34Syl.

This operation aims to detect the presence of some strong form of isochrony, and at the same time the ability of FAT and MAT groups to exhibit that feature. To that end, we make calculations similar to those detailed in Chapter Three. First we calculate the durations of the individual realisations for each informant within each group. They appear in *Calculation Booklet: The Rhyme: Parts Durations*.

We then calculate the NAS means to set the norm, both for actual durations and for increment increase. These calculations concern the five parts of the Rhyme. A table is displayed for each of the five parts of the rhyme. Once the norms are set, we weight the FAT and MAT group results against them for each of the five parts in a table form and see how the FAT and MAT results behave. Some observations follow each table. Like for the other operations, the measuring tool is WASP.

Step One: Setting the Norms

First we calculate the mean durations of NAS for each part. Here is a sample limited to the first part of the operation. The second column gives the durations of Part 1. The individual performances are added up, and we get 5,382. To get the mean duration, we divide the total obtained by the number of informants. In our example, 5,382 divided by 4 makes 1,346.

	Rhyme Part 1
NAS1	1,145
NAS2	1,524
NAS3	1,399
NAS4	1,314
Total Duration of Part 1	5,382
Mean Duration	**1,346**

We apply the same procedure to the five parts of the rhyme and we obtain the following results. We can get the Mean Duration of the five parts by adding up the individual means and dividing by 5, the number of parts.19,088 / 5 =3,818

	Part 1	**Part 2**	**Part 3**	**Part 4**	**Part 5**	**NAS Mean**
NAS1	1,145	2,657	3,168	3,974	5,843	
NAS2	1,524	3,051	3,639	4,279	5,890	
NAS3	1,399	3,453	4,370	5,445	7,427	
NAS4	1,314	2,953	3,808	4,615	6,397	
Total Duration of Part 1	5,382	12,114	14,985	18,313	25,557	
Mean Duration	**1,346**	**3,029**	**3,746**	**4,578**	**6,389**	**3,818**

Step Two: Calculating FAT and MAT Mean Durations

Following the procedure described above, we calculate the same means for the FAT and the MAT groups for each part of the rhyme.

	Part 1	**Part 2**	**Part 3**	**Part 4**	**Part 5**	**MAT group**
Mean						
MAT1	2,043	4,026	5,836	6,448	8,719	
MAT2	1,332	3,174	3,857	5,668	6,961	
MAT3	2,231	4,713	7,087	8,531	10,465	
MAT4	1,863	3,641	4,336	5,276	6,816	
MAT5	1,877	3,524	4,543	5,639	7,396	
Mean Duration	**1,869**	**3,816**	**5,132**	**6,312**	**8,071**	**5,040**

Now we do the same for the FAT group.

	Part 1	**Part 2**	**Part 3**	**Part 4**	**Part 5**	**FAT group**
FAT01	1,464	3,777	5,060	6,562	7,713	
FAT02	2,231	5,544	7,178	9,032	12,158	
FAT03	1,993	4,327	5,361	6,971	10,095	
FAT04	1,524	4,079	5,064	5,099	7,801	
FAT05	1,771	3,851	4,452	5,998	7,989	
FAT06	1,410	3,882	4,511	5,765	7,818	
FAT07	1,499	3,821	5,457	5,850	9,444	
FAT08	1,582	3,381	4,451	5,235	7,799	
FAT09	1,610	3,373	4,133	4,921	6,720	
FAT10	1,567	3,571	4,175	5,859	7,424	
FAT11	1,650	3,910	5,350	6,785	9,048	
FAT12	1,691	4,693	5,896	7,483	10,716	
FAT13	1,532	3,782	5,238	6,551	9,493	
FAT14	1,626	4,020	5,431	6,741	9,456	
FAT15	1,620	4,377	5,564	6,661	9,275	
FAT16	1,863	4,474	5,810	7,023	10,000	
FAT17	1,668	4,472	6,252	7,197	10,123	
FAT18	1,606	3,600	5,005	6,151	8,866	
FAT19	1,966	3,767	4,872	5,030	6,662	
FAT20	1,847	3,216	4,138	5,020	7,053	
FAT21	1,831	3,772	4,959	6,170	8,310	
FAT22	1,745	3,609	4,537	5,729	7,450	
FAT23	1,852	3,695	4,694	6,137	8,201	
FAT24	1,501	3,676	4,846	5,114	7,811	
FAT25	1,898	3,409	4,487	5,237	7,432	
Mean Duration	**1,702**	**3,923**	**5,077**	**6,173**	**8,594**	**5,094**

Step Three: Comparing the Three Means

The table below shows the mean durations for each part of the rhyme as realised by the three groups of informants, the norm being set by NAS as usual.

	Part 1	**Part 2**	**Part 3**	**Part 4**	**Part 5**	**Overall**
Number of Syllables	4_7	8_16	10_20	12_25	16_34	
NAS / Norm	1,346	3,029	3,746	4,578	6,389	3,818
FAT Mean Duration	1,702	3,923	5,077	6,173	8,594	5,094
MAT Mean Duration	1,869	3,816	5,132	6,312	8,071	5,040

Comments

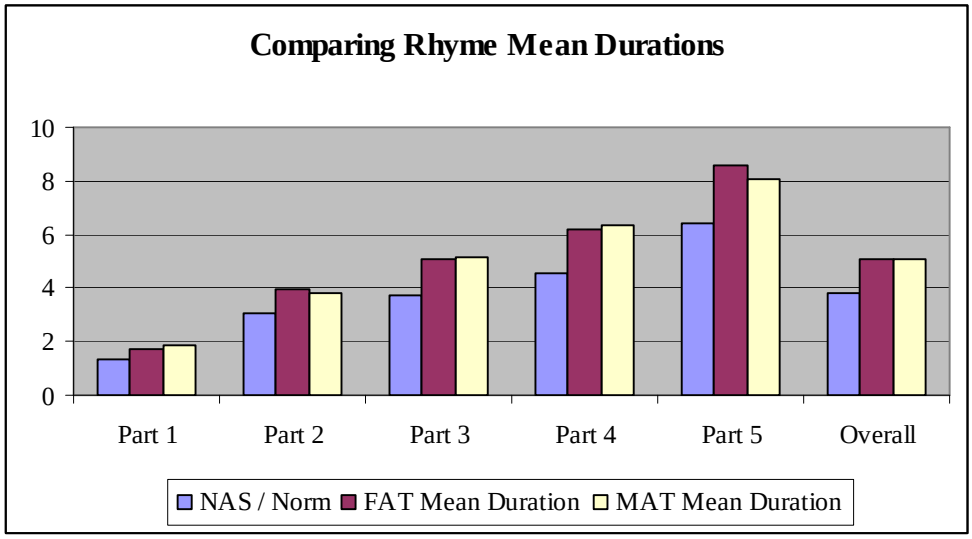
An important observation in favour of isochrony concerns the NAS group. Mean Duration increases almost at the same rate as the number of stressed syllables in the rhyme. For example, Part 2 with 8 stressed syllables is realised by NAS in 3,029 seconds. In Part 5, the

number of stressed syllables doubles, and so (take or leave imperceptible milliseconds) does the time taken to read that Part. This feature should be more obvious when we look at increment rates.

Another recurring observation is that the gap between NAS and the FAT and MAT groups increases as the number of syllables increases, as made clear in the table under Step Three.

Another observation is a feature shared by all three groups: it concerns (roughly) the doubling of durations from Part 1 to Part 2 as the number of stressed syllables is multiplied by 2.

The following graph makes things clearer visually.



Graph 10: Comparing Rhyme Mean Durations

Step Four: Calculating the Standard Deviation

The standard deviation is calculated first for each part of the rhyme, and then for the rhyme as a whole. Using the function in Microsoft Office Excel 2003, we obtain the following data.

Standard Deviation	Rhyme Part 1	Rhyme Part 2	Rhyme Part 3	Rhyme Part 4	Rhyme Part 5	Overall SD
Number of Syllables	4_7	8_16	10_20	12_25	16_34	
NAS	0,159	0,329	0,496	0,634	0,736	0,471
FAT	0,195	0,506	0,715	0,965	1,358	0,748
MAT	0,335	0,587	1,316	1,312	1,534	1,017

Comments

A notable element is that the Standard Deviation gets further and further from zero for all the groups, including NAS as the number of syllables increases. It is probably due to the fact that some informants, natives and non natives alike, read the rhyme non-stop in one go while others marked pauses after each line. Many FAT and MAT hesitated before certain words, such as 'crumpled', 'tossed', 'malt', 'horn'. This may account for the spread out SD.

A recurrent feature is the heterogeneity of the MAT group which increases as the number of syllables increases.

Step Five: Calculating the Increment Rates

In the previous steps in this operation, the actual performance durations are measured in seconds. But some people talk fast, others more slowly. As mentioned previously, one way of bypassing the issue of individual differences in speeds of speech flow, is to turn to the calculation of increment rates for all the groups. Using the procedure detailed in Chapter Three of this research, we calculate the increment rates. They appear under each part of the rhyme for the group concerned.

	Part 2	Part 3	Part 4	Part 5	Mean
Number of RUs	8	10	12	16	
NAS	2,260	1,235	1,222	1,399	1,529
FAT	2,322	1,294	1,217	1,395	1,557
MAT	2,060	1,330	1,247	1,282	1,480

Lets us now calculate the increment rate of the RUs.

	Part 1	Part 2	Part 3	Part 4	Part 5
Number of RUs	4	8	10	12	16
Increment rate		2,00	1,25	1,20	1,33

If we bring these two increment tables together and read the groups' increments against the stressed syllables increments, we can make interesting observations.

Here is the table bringing together the two types of increment rates.

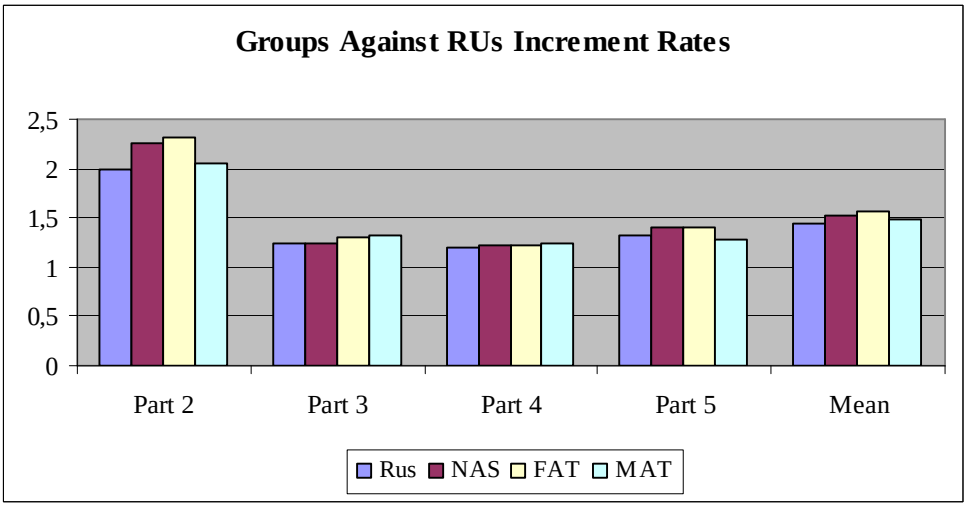
	Part 1	Part 2	Part 3	Part 4	Part 5	Mean
Number of RUs	4	8	10	12	16	
RU_Increment rate		2,000	1,250	1,200	1,330	1,450
NAS		2,260	1,235	1,222	1,399	1,529

FAT		2,322	1,294	1,217	1,395	1,557
MAT		2,060	1,330	1,247	1,282	1,480

Comments

The first observation is that the increment rate of all the groups increases at almost the same pace as that of the RUs. For example, the number of stressed syllables from Part 3 to Part 4 has been multiplied by 1,200 and the increment rates of the NAS, FAT and MAT groups have increased by 1,222, 1,217 and 1,247. This is a very strong point in favour of isochrony.

The second observation is that for the NAS group, the increment rate of their production follows very closely that of the stressed syllables. It confirms the existence of a fairly strict form of isochrony in the rhyme. It is perceptible, but less obvious for the local groups.



Graph 11: Comparing Groups and RUs Increments

Operation Three: Comparing Utterance 4RU_7Syl and Part One of Rhyme

The corpus for this operation includes two stretches of speech which have the same number of stressed syllables and the same number of unstressed syllables. The first is Utterance 4RU_7Syl is '*He likes horror films a lot.*' and the second is Part 1 of the Rhyme which is '*This is the house that Jack built.*' It is honest to say that the Utterance has been selected for no other reason than the fact that it has the same syllabic structure (Seven syllables, four of which are stressed) as Part 1 of the Rhyme. For the sake of convenience we refer to 'He *likes horror films a lot.*' as the Utterance; to '*This is the house that Jack built.*' as Part 1; and if we need to refer to both of them, we shall use the word 'sentences'.

The objective of this operation is to assess if the two sentences behave similarly and more specifically if some form of isochrony is present in the utterance as it appears to be in the rhyme.

We hope to achieve this in three steps. First we calculate individual and group NAS Mean Durations of the corpus to set the norms. After that, we calculate FAT and MAT individual and group durations for the same corpus. Next, we calculate individual deviations from the norms set by the means of the native speakers, and the standard deviations for each group. Our raw material is the durations obtained through WASP and which are in the *Calculation Booklet*.

Step One: Setting the Norms

First, we calculate the mean durations for the two sentences from the related data which appears in the *Calculations Booklet*. Using the procedure detailed in the beginning of Chapter 3, we calculate the means for the two sentences.

	4_7 Utterance	**Part 1**
NAS1	1,413	1,145
NAS2	1,555	1,524
NAS3	1,390	1,399
NAS4	1,128	1,314
NAS Mean / Norm	**1,372**	**1,346**

The first observation is that the mean duration of Part 1 is shorter than that of the utterance. At the individual level, no clear pattern appears: two informants (NAS2 and NAS3) say the two sentences in about the same time; NAS1 says Part 1 more quickly than the utterance while NAS4 says the utterance more quickly than Part 1.

We now calculate the duration of FAT's and MAT's realisations and compare them with the norm. The fourth column represents the difference between the utterance duration is subtracted rhyme duration. It is negative when the utterance takes less time to say and the part of the rhyme is therefore longer. The calculations based on the rough data in the *Calculations Booklet* yield the following results:

	4_7 Utterance	Part 1		Duration Difference
NAS Mean / Norm	1,372	1,346		0,026
FAT Mean	1,691	1,702		-0,011
MAT Mean	1,537	1,869		-0,332

The first observation is that for NAS, Part 1 is shorter than the utterance, while it is longer for the non native groups.

The second observation we can make is that for both FAT and MAT, Part1 is slightly longer for the FAT group, or considerably longer for the MAT group than Part 1.

We turn now to Standard Deviation for the three groups.

	4_7	Part 1
NAS Standard Deviation	0,178	0,159
FAT Standard Deviation	0,166	0,195
MAT Standard Deviation	0,261	0,335

Except for the recurring fact that FAT are usually more clustered and MAT more spread apart, nothing has been revealed by this step of the operation.

MAT Individual Performances

Since the Group means do not reveal much, we move to the individual realisations of MAT and see if they are more telling.

	4_7	**Part 1**	Duration Difference
Norm set by NAS	**1,372**	**1,346**	0,026
MAT1	1,716	2,043	-0,327
MAT2	1,219	1,332	-0,113
MAT3	1,878	2,231	-0,353
MAT4	1,471	1,863	-0,392
MAT5	1,399	1,877	-0,478
MEAN	**1,537**	**1,869**	-0,332

Comments

The duration difference in the right hand column shows all the MAT informants read the utterance faster than the rhyme. Except for MAT2, who happens to have a very fast rate of delivery, the differences between the utterance and Part 1 are considerable. This may be due to the fact that the NAS read Part 1 as the traditional rhyme they know they have to rush through, and the MAT 'read' it attentively while they 'spoke' the utterance more naturally.

FAT Individual Performances

Let us look at FAT performances.

	4_7	**Part 1**	**Duration difference**
Norm set by NAS	**1,372**	**1,346**	**0,026**
FAT01	1,619	1,464	0,155
FAT02	1,809	2,231	-0,422
FAT03	1,716	1,993	-0,277
FAT04	1,656	1,524	0,132

FAT05	1,622	1,771	-0,149
FAT06	1,700	1,410	0,29
FAT07	1,795	1,499	0,296
FAT08	1,648	1,582	0,066
FAT09	1,452	1,610	-0,158
FAT10	1,874	1,567	0,307
FAT11	1,627	1,650	-0,023
FAT12	1,948	1,691	0,257
FAT13	1,357	1,532	-0,175
FAT14	1,877	1,626	0,251
FAT15	1,729	1,620	0,109
FAT16	1,705	1,863	-0,158
FAT17	1,499	1,668	-0,169
FAT18	1,327	1,606	-0,279
FAT19	1,807	1,966	-0,159
FAT20	1,682	1,847	-0,165
FAT21	2,013	1,831	0,182
FAT22	1,842	1,745	0,097
FAT23	1,620	1,852	-0,232
FAT24	1,677	1,501	0,176
FAT25	1,666	1,898	-0,232
Mean	**1,691**	**1,702**	**-0,011**

Comments

Thirteen out of twenty-five female informants, or 52%, realise the utterance faster than the rhyme, while for the other 48%, the rhyme is faster. The difference goes from -0,422 for FAT02 (who happens to be a very slow speaker) to 0,307 for FAT10, an experienced teacher who knows that the rhyme is supposed to be rushed through and who tries to articulate as best she can when reading the utterance.

We move to another measuring instrument, the metronome, to put the Rhyme to the test of strict isochrony.

Operation Four: Metronome Analysis of Rhyme

The corpus for this operation is the rhyme. In this operation, we try to see if the rhyme, or a part of it, can pass the metronome test. The objective is to gauge the presence of strong isochrony in the informants' realisations of the rhyme: any part of the rhyme can be adequate, but the longer the part, the better. A musical metronome, as described in *Appendix 7* is used for this experiment. The musical metronome is set at different beats (or blinks) per measure until it appears to match the rhythm of the informant to a great extent, at least as far as the ear can perceive. Once the appropriate rhythm is found, that is when the metronome's beats (or

blinks) and the informant's realisation are isochronous, the number of beats per measure or per minute is recorded. The big problem in this activity is to have the beat or blink of the metronome sound or flash at exactly the same time as the first RU of the informant's realisation. And that is no easy task by any means.

Results

The informants have been divided into four groups based on how easy it is to measure their Bpm for group 1 to how difficult or impossible it is.to measure their Bpm for the last group.

Some realisations are easier to measure in the sense that the RUs are audibly quite prominent and they contain neither pauses nor hesitations. The less prominent the RUs become, and the more stops or pauses or hesitations there are, the more difficult it is to measure the Bpm, and consequently, the informants are ranked further and further down the scale, all the way down to Class 4.

Class 1 informants

The list includes the following.

Informant	Beats per measure / minute
NAS1	166
NAS2	158
NAS3	122
NAS4	148
FAT05	136
FAT09	140
FAT18	1 45
FAT25	128
MAT4	145
MAT5	130

The list naturally includes the four native speakers even if they are not R.P. speakers, and then four FAT and two MAT representatives. Statistically, that makes 100% of the native speakers, (4 out of 4), 40% of MAT (2 out of 5) and 16% of FAT (4 out of 15).

Next come certain realisations in which the tempo varies a lot. The informants start at a fairly regular pace, and go on rushing through the rhyme very quickly towards the end, but the Bpm is still measurable to some extent. It requires more effort and a greater number of attempts. The list appears on the next page.

Class 2 Informants

Informant	Beats per measure / minute
FAT01	140
FAT07	126
FAT08	134
FAT10	144
FAT16	112
FAT19	136
FAT20	142
FAT21	134
FAT22	136
FAT24	128
FAT04	142

Eleven out of twenty-five female teachers are included in this list. They constitute 44% of the FAT population or 36,66% of the teaching body of the Wilaya. We note the total absence of MAT representatives in this category.

The third group includes informants who hesitate too much, or stop too often, or do not read the rhyme the way it should be read. In a nutshell, it is hard to find a long enough stretch of speech to analyse.

Class 3 Informants

Informant	Beats per measure / minute
FAT02	
FAT06	125 towards the end
FAT11	
FAT12	
FAT13	
FAT14	105 but irregular
FAT17	105
MAT1	100

Seven FAT, or 28% and one MAT, or 20% are included in this Class.

The last group includes informants who are absolutely impossible to measure, either because their English is more syllable-timed than stress-timed, or because their tempo changes too much and is too choppy. This may be due partly to their unfamiliarity with the rhyme. The list appears on the next page.

Class 4 Informants

Informant	Beats per measure / minute
FAT03	Syllable-timed
FAT15	Too many stops
FAT23	Impossible
MAT2	Too irregular
MAT3	Not read as a rhyme

The group includes three local female informants, that is 12% of FAT, and two male informants, or 40% of MAT.

The following table summarises the results of the metronome test with some observations. It is worth noting that for those ranked number 1 in the Ranking column, we tried to measure their 'beats per measure' other times. It was always feasible, but we got different numbers of bpm every time. The range was as wide as 20 bpm, from 120 bpm the first time to 140 the second time and 130 a third time, especially with informants who speak quickly. In fact, the more quickly they spoke, the wider the gap between one measurement and another. The Bpm in the second column should be taken with caution.

Informant	**Bpm**	**Ranking**	**Observations**
NAS1	166	1	Bpm easily measurable
NAS2	158	1	Bpm easily measurable
NAS3	122	1	Bpm easily measurable
NAS4	148	1	Bpm easily measurable
FAT05	136	1	Bpm easily measurable
FAT09	140	1	Bpm easily measurable
FAT18	145	1	Stops after each line but fluent
FAT25	128	1	Bpm easily measurable
MAT4	145	1	Bpm easily measurable
MAT5	130	1	Bpm easily measurable
FAT01	140	2	Pauses
FAT04	142	2	Jack (schwa) built
FAT07	126	2	Too many pauses
FAT08	134	2	
FAT10	144	2	Hesitations
FAT16	112	2	With a pause
FAT19	136	2	Except at the end when she rushes through
FAT20	142	2	Irregular

FAT21	134	2	Hesitations
FAT22	136	2	
FAT24	128	2	Rushes through towards the end
FAT02		3	Too many pauses
FAT06		3	Impossible: too many pauses
FAT11		3	Too many stops
FAT12		3	Not read as a rhyme
FAT13		3	Too many stops
FAT14		3	Not read as a rhyme
FAT17		3	Not read as a rhyme Too many hesitations
MAT1		3	Too many pauses
FAT03		4	Impossible: Syllable-timed
FAT15		4	Too many stops
FAT23		4	Jack (schwa) built
MAT2		4	Not read as a rhyme
MAT3		4	Not read as a rhyme

This chapter shows clearly that there exists some form of isochrony in the realisation of the Rhyme. The local teachers' realisations tend towards that feature, but the gaps with the native speakers widen as the number of syllables increases.

General Conclusion

Analysis

English is by nature a rhythmic language. The correct use of rhythmic patterns is conditioned by the components that are not easy to acquire for a foreign learner of English.

Perception of isochrony

As stated by Couper-Kuhlen (1990), perceived isochrony does not seem to have a physical correlate that can be found in terms of temporally equidistant rhythm units – at least not in the data presented in this study. Yet all listeners are aware of isochrony, can report it consistently and can report isochrony errors. Whatever perception is bringing to the cognitive assignment of isochrony, we suggest the act is mediated by an acoustic signal to which the listener is demonstrably sensitive – as evidenced by the detection of errors.

Other points noted

- Stress is not sufficiently marked by the non native speakers,
- No vowel reduction: Vowels are not shortened in unstressed syllables, which gives the impression that all syllables are equally important,
- Recurrence of rhythm in the rhyme is not marked,
- Pauses are not long enough when two stressed syllables follow each other or the first stressed syllable is followed by a schwa,

Suggestions and Perspectives

The importance of rhythm in language learning: Implications for the classroom

EFL teachers often tend to focus on grammar and vocabulary, leaving out the prosody of the language, i.e. the supra-segmental features as indicated earlier on.

When they deal with pronunciation, they generally focus on segmental aspects, namely phonemes and allophones, at most to the level of syllables.

This research attempts to address the supra-segmental aspects of speech production namely, rhythm in the English language because training the learner's skill to perceive the supra-

segmental traits may help learners improve their overall articulation and expand their oral and aural capacities, such as producing and responding correctly to intonation due to pitch awareness, stress, co-articulation, rhythm and voice quality.

The correct use of these rhythmic patterns is one of the most difficult things to acquire for a foreign learner of English. The improper extension to English of different rhythmic patterns borrowed from one's mother tongue is one of the elements that a native English speaker immediately recognises as indicative of a foreign accent.

Rhythm, as one of the most important prosodic features of English, is essential in language acquisition and competent language use. Adams (1979) points out that the inadequate control of rhythm is the ultimate barrier to fluency and comprehensibility at all levels of usage and she considers the command of rhythm as the key component in the mastery of the spoken language. She suggests that EFL-ESL learners, unable to recognise the importance of syllable timing, may produce speech with anomalous rhythm that may severely damage the overall intelligibility of their speech. This has received strong support by Taylor (1981), who points out that rhythm might be the most commonly experienced difficulty among learners of English. Despite the challenges facing both teachers and learners, the teaching and learning of English rhythm is a must in the processes of language acquisition (Adams 1979; Wong 1987; Graham 1992). Many authors argue that when teaching English as a foreign or a second language, it is important to teach also its rhythm. The teaching of rhythm should be extensively practised in our classroom at all levels.

Classroom teachers often raise the big question of how best to teach rhythm when they are not native speakers of English and how they themselves can best acquire the rhythmical patterns in speech before they are able to transmit them in a correct way.

Investigations of the acquisition of speech rhythm by foreign learners of English are quite rare. The main reason for this seems to be the somewhat elusive nature of speech rhythm and how it can be qualified.

Recent research by Ramus, Nespor and Mehler (1999), Low, Grabe and Nolan (2001), and Grabe and Low (2002) has been aimed towards the development of an acoustic correlate of speech rhythm which permits the comparison of rhythm in real speech data.

Operation number 10: "Forcing" isochrony
Corpus: Sets 1, 2, 3

Objective: Force isochrony; Can informants perceived as poor performers force isochrony and say, not sing or rap, sets 1, 2, or 3 to the beat of a metronome?

Technique: Read each set under a given number of bpm of the metronome

Tool: The metronome

Sample of Operation 10

Informant	BPM	Set	
MAT4	110	1	
MAT4	110	2	
MAT4	120	3	
NAS1	120	1	
NAS1	120	2	
NAS1	146	3	Just about
FAT08	136	1	
FAT08	136	2	
FAT03	140	3	

Utterance	#RU	#Syl
John likes bread.	3	3
John likes chocolate.	3	4
Betty likes chocolate.	3	5
My children like chocolate.	3	6
The children are eating bread.	3	7
Our children are eating chocolate.	3	8

General Conclusion

The classification is based on the realisation of rhythm alone, the beat, and ignores other features whose importance cannot be denied, such as the quality of individual sounds, etc.

Objective 1: What is the state of the art?

It has been made clear through the EPA evaluation that his research

If we look at the results from a statistical point of view,
The results shown by the various operations in this research
The result shown at the en d of chapter **EPA**

- FAT 16% are at the lowest rung of the ranking ladder
- Page 37

MAT page 40

Chapter 4
The longer the utterance, the bigger te gap with NAS, especially FAT group

Chapter 5
FAT are close to NAS than FAT
Thegap increases with long er stretches of speech.

See table page 65

Objective 2:Confirm or invalidate CONFIRM or invalidate

Rhyme yes, as proven with Operation 2:
No problem with monosyllabic words as seen with Operation 1 chap 5

Objective 3: Poor realisation of rhythm lead to unintelligibility

Exmple : got poor mark in EPA, and cannot be understood, choppy deivery (FAT03, 06, 04, 24
Less obvious with boys
Additions and elisions and stressing the unstressed (liste des fautes)
SD gets farther from zero as number of syllables increases

Objective 4: Differences between males and females:

Chap 3 EPA statistical tables page 48 (see observations
Chap 4: Op 1 (Sets) page 55 MAT closer to the norm. confirmed by the means increment rates.
FAT are more homogeneous SD page 57
Confirmed by SD page 58 The longer the set the more problems
Opration 3: Pairs

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Glossary

Amplitude:	The instantaneous magnitude of an oscillating quantity such as sound pressure. The peak amplitude is its maximum value.
Beats:	Periodic fluctuations that are heard when sounds of slightly different frequencies are superimposed, can be measured by a metronome in music, or tapping on the table for speech.
Formant:	A formant is a dark band on a dark band spectrogram, which corresponds to the a vocal tract resonance. Technically, it represents a set of adjacent harmonics which are boosted by a resonance in some part of the vocal tract.
Hertz:	The unit of frequency, abbreviated Hz. The same as cycles per second.
Rhythmic Unit:	*A rhythmic unit* is the temporal interval from the start of a stressed syllable to the start of the next stressed syllable: that is, a rhythmic unit always begins with a stressed syllable (see Jassem 1952 for the use of the term).
Sound spectrograph:	An instrument that displays the time, level, and frequency of a signal.
Sound:	Sound is vibrational disturbance, exciting hearing mechanisms, transmitted in a predictable manner determined by the medium through which it propagates. To be audible the disturbance must fall within the frequency range 20Hz to 20,000Hz.
Spectrum:	The distribution of the energy of a signal with frequency.
Standard deviation :	It is the root mean square (RMS) deviation of values from their arithmetic mean. For example, in the population {4, 8}, the mean is 6 and the standard deviation is 2. In this case 100% of the values in the population are at one standard deviation of the mean. The standard deviation is the most common measure of statistical dispersion, measuring how widely spread the values in a data set are. If the data points are close to the mean, then the standard deviation is small. As well, if many data points are far from the mean, then the standard deviation is large. If all the data values are equal, then the standard deviation is zero. (See Appendix 8)
Stressed syllable:	A *stressed syllable* is one which bears phonological primary stress: that is, some kind of planned prominence which can also be perceived from the acoustic signal. The prominence distinguishes it from other, less prominent syllables. There is no fixed acoustic correlate of prominence, but it may be correlated with enhanced amplitude, increased duration or abrupt change of fundamental frequency – or all three in any combination (Fry 1958). The
Syllable:	A *syllable* is a phonological unit which forms the basis of the prosodic parameters of rhythm, stress and intonation – it is defined in terms of its hierarchically organised structure based on its segmental (consonantal and vocalic) composition. Syllables must have one vowel as their nucleus with margins where, in English, from zero to three consonants precede the nucleus and from zero to four consonants follow the nucleus: 4 0 3 *C*0*VC* (Gimson 1962; see also van der Hulst and Ritter 1999 for a collection of

	much wider discussions on the nature and structure of syllables)
Tone:	A term used in phonology to refer to the distinctive pitch level of a syllable. In the study of intonation, a sequence of tones constitutes a contour or tone unit. The most prominent tone in a tone unit may be referred to as a nuclear tone. Distinctive feature theories of phonology propose features of tone, such as high, low, and mid. The ones which vary in pitch range are called contour, kinetic or dynamic tones; those which do not vary in range are static or level tones. See Crystal 1969: Ch. 4; Ladefoged 1982: Ch. 10; Hyman 1975: Ch. 6.

Appendices

Appendix 1: Calculations Booklet
See the last 20 pages of the document

Appendix 2: Initiators and Rejoinders

	Initiator	Rejoinder	RU	Syl
	Who called?	John	1	1
	Where's Mary?	She left.	1	2
	Who is with Mary?	She's alone.	1	3
	Where's John?	He is at work.	1	4

	What's your name?	John Smith.	2	2
	Who came?	John and Ann.	2	3
	How do you like your steak?	I like it rare.	2	4
	Where's Lara?	She's taking a bath.	2	5
	What's your Mum doing?	She's having her breakfast.	2	6
	What did you do?	We listened to some music.	2	7

	What happened?	Ann left Bill.	3	3
	What did John do?	He bought two cars.	3	4
	Why didn't you go out?	It's raining too hard.	3	5
	You're working hard today!	I have a lot to do.	3	6
	Look at Mary.	I've never seen her dancing.	3	7
	What did you see?	I saw the accident happen.	3	8

	What did she say?	John left home late.	4	4
	What did you say?	Bill shouts all the time.	4	5
	What did Mary do in the end?	She bought a new French car.	4	6
	What sort of films does John like?	He likes horror films a lot.	4	7
	Did you play any sport when you were a kid?	I used to play tennis a lot.	4	8
	What a coffeeholic!	I started drinking tea recently.	4	9
	You look happy.	I fell in love with a beautiful girl.	4	10
	Why pack up?	I'm leaving on vacation next Saturday.	4	11

	What's its title?	John Smith Loves Ann White.	5	5

Appendix 3: The Rejoinders in Phonetic Script

	Rejoinders	[rɪdʒɔɪndəz]
1_1	John	[dʒɔn]
1_2	She left.	[ʃɪ left]
1_3	She's alone.	[ʃɪz əlәʊn]
1_4	He is at work.	[hɪ ɪz ət wɜ:k]

2_2	John Smith.	[dʒɔn smɪθ]
2_3	John and Ann.	[dʒɔn ən æn]
2_4	I like it rare.	[aɪ laɪk ɪt rɛə]
2_5	She's taking a bath.	[ʃɪz teɪkɪŋ ə bɑ:ə]
2_6	She's having her breakfast.	[ʃɪz hævɪŋ hə brekfəst]
2_7	We listened to some music.	[wɪ lɪsənd tə səm mju:zɪk]

3_3	Ann left Bill.	[æn left bɪɬ]
3_4	He bought two cars.	[hɪ bɔ:t tu:kɑ:z]
3_5	It's raining too hard.	[ɪts reɪnɪŋ tu: hɑ:d]
3_6	I have a lot to do.	[aɪ hæv ə lɔt tə du:]
3_7	I've never seen her dancing.	[aɪv nevə sɪ:n hə dɑ:nsɪŋ]
3_8	I saw the accident happen.	[aɪ sɔ: ðɪ æksɪdənt hæpən]

4_4	John left home late.	[dʒɔn left həʊm leɪt]
4_5	Bill shouts all the time.	[bɪl ʃaʊts ɔ:l ðə taɪm]
4_6	She bought a new French car.	[ʃɪ bɔ:t ə nju: frentʃ ka:]
4_7	He likes horror films a lot.	[hɪ laɪks hɔrə fɪlmz ə lɔt]
4_8	I used to play tennis a lot.	[aɪ ju:st tə pleɪ tenɪs ə lɔt]
4_9	I started drinking tea recently.	[aɪ stɑ:tɪd drɪŋkɪŋ tɪ: rɪ:səntlɪ]
4_10	I fell in love with a beautiful girl.	[aɪ fel ɪn lʌv wɪð ə bju:tɪful gɜ:l]
4_11	I'm leaving on vacation next Saturday.	[aɪm lɪ:vɪŋ ɔn vəkeɪʃn nekst sætədeɪ]

5_5	John Smith Loves Ann White.	[dʒɔn smɪθ lʌvz æn waɪt]

Appendix 4: The Rhyme in Phonetic Script

Part One:

This is the house that Jack built.	[ðɪs ɪz ðə haʊs ðət dʒæk bɪlt]

Part two:

This is the rat	[ðɪs ɪz ðə ræt]
That ate the malt	[ðət eɪt ðə mɔlt]
That lay in the house that Jack built.	[ðət leɪ ɪn ðə haʊs ðət dʒæk bɪlt]

Part three:

This is the cat,	[ðɪs ɪz ðə kæt]
That killed the rat,	[ðət kɪld ðə ræt]
That ate the malt	[ðət eɪt ðə mɔlt]
That lay in the house that Jack built.	[ðət leɪ ɪn ðə haʊs ðət dʒæk bɪlt]

Part four:

This is the dog,	[ðɪs ɪz ðə dɔg]
That worried the cat,	[ðət wərɪd ðə kæt]
That killed the rat,	[ðət kɪld ðə ræt]
That ate the malt	[ðət eɪt ðə mɔlt]
That lay in the house that Jack built.	[ðət leɪ ɪn ðə haʊs ðət dʒæk bɪlt]

Part five:

This is the cow with the crumpled horn,	[ðɪs ɪz ðə kaʊ wɪð ðə krʌmpld hɔ:n]
That tossed the dog,	[ðət tɔst ðə dɔg]
That worried the cat,	[ðət wərɪd ðə kæt]
That killed the rat,	[ðət kɪld ðə ræt]
That ate the malt	[ðət eɪt ðə mɔlt]
That lay in the house that Jack built.	[ðət leɪ ɪn ðə haʊs ðət dʒæk bɪlt]

Appendix 5: Informant's Questionnaire

Name: (Optional) Sex: Age: Code:

Degrees held:

Country	Degree	Date:

Learning Experience

Institution	Middle School	Secondary School	College	Abroad
Duration				

Teaching Experience

Institution	Middle School	Secondary School	College	Abroad
Duration				

Languages spoken at home

Arabic	French	Tamazight	Other	Combination

Mother Tongue

Yours	Arabic	French	Tamazight	Other	Combination
Father's	Arabic	French	Tamazight	Other	Combination
Mother's	Arabic	French	Tamazight	Other	Combination
Spouse's	Arabic	French	Tamazight	Other	Combination

City of origin

Father's	Mother's	Spouse's

Hometown(s) in the last twenty years

From	To	In

Sojourns in English speaking countries

Place	Reason	Duration	Date

English speaking TV channels watched

Name	Weekly average in hours

Use of English outside school teaching

Opportunity	Frequency

When did you last speak to a native English speaker?

Thank you for your help and dedication.

Appendix 6: The WASP

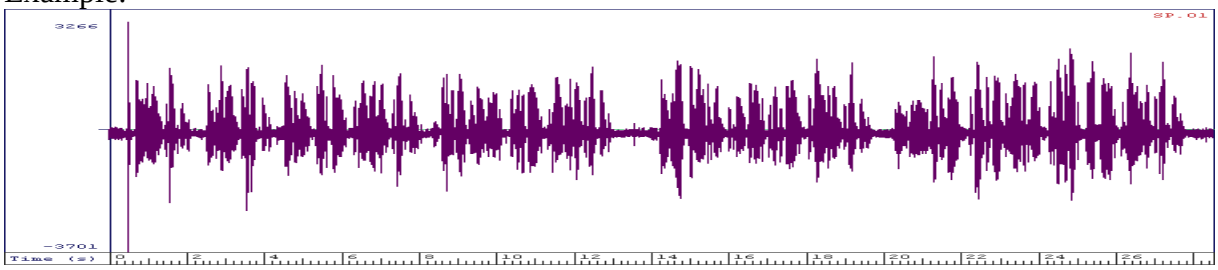
Wasp

Wasp is software developed in 2004 by Mark Huckvale from the Department of Phonetics and Linguistics of University College, London.

Waveform

A waveform is a graph of signal amplitude (on the vertical axis) against time (on the horizontal axis). Conventionally, the zero line is taken to mean no input: in terms of a microphone this would imply that the sound pressure at the microphone was the same as atmospheric pressure. Positive and negative excursions can then be considered pressure fluctuations above and below atmospheric pressure. For speech signals these pressure fluctuations are very small, typically less than +/- 1/1000000 of atmospheric pressure. The amplitude scale used on waveform displays merely records the size of the quantised amplitude values captured by the Analogue-to-Digital converter in the PC. These have a maximum range of -32,768 to +32,767. If you observe values close to these on the display, it is likely that the input signal is overloaded.

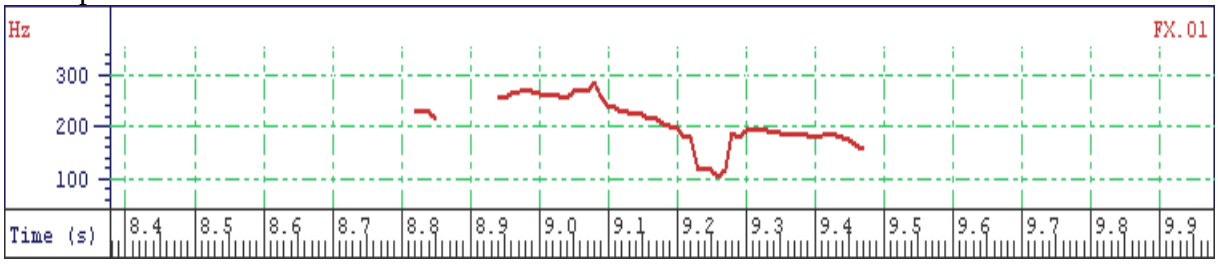
Example:



Fundamental frequency track

The fundamental frequency track shows how the pitch of the signal varies with time. Pitch is properly a subjective attribute of the signal, but it is closely related to the *repetition frequency* of a periodic waveform. Thus if a signal has a waveform shape that repeats in time (such as a simple vowel) then we perceive a pitch related to how long the signal takes to repeat. A signal with a long repetition period (low repetition frequency) has a low pitch, while a signal with a short repetition period (high repetition frequency) has a high pitch. The proper name for the repetition frequency of periodic waveforms is called the *fundamental frequency* because this frequency has an important role in determining which frequency components are present in a periodic signal. A signal that is periodic at F Hz, can only have frequency components at F, 2F, 3F, ...; these are called the harmonic components (or just harmonics) of the signal.

Example:



Note that all algorithms for estimating the fundamental frequency from the speech signal do fail on some occasions. This is because of the complexity of the speech signal and the influence of any interfering noise. Where the algorithm is unable to determine any effective

periodicity in the signal, no fundamental frequency estimate is displayed. The algorithm is optimised for human speech signals, so may fail to find the correct pitch for musical instruments and other sounds.

Time

Time is indicated, down to the thousandth of a second.

Appendix 7: The Metronome

Weird Metronome

Version 1.4
Weird Metronome is a flexible software that can have an arbitrary beats per measure and can blink or produce a sound regularly, according to the number you have set.
It was created by David Johnston. The version we use (Version 1.4) was developed in 2004.
Weird Metronome is set to blink and or produce a musical on every beat.

Appendix 8: Standard Deviation

The **standard deviation** is a statistic that tells you how tightly all the various data are clustered around the mean in a set of data. When the examples are tightly bunched together and the bell-shaped curve is steep, the standard deviation is small and the groups of informants is homogeneous.. When the data are spread apart we have a relatively large standard deviation, further from zero and the group is heterogeneous.

Terms necessary to calculate the standard deviation
x = one value in your set of data, in our case the duration of an utterance, or a set, or n RU_or a rhyme, or a syllable.
avg (x) = the mean (average) of all values x in our set of data,
n = the number of values x in our set of data, that is for for NAS, 25 for FAT and 5 for MAT
For each value x, we subtract the overall avg (x) from x, then multiply that result by itself (otherwise known as determining the square of that value). We add up all those squared values. Then we divide **that** result by (n-1). Finally we calculate the square root of that last number. **That's** the standard deviation of our set of data.
The more practical way to compute it as we did was to use the standard deviation function provided in Excell provided by Microsoft Office 2003.

Appendix 9: Koss Headphone

SB45 Multi-Media Stereophone

Frequency Response	Stereophone: 18Hz - 20,000 Hz Microphone: 100-16,000Hz
Impedance	Stereophone: 100 ohms Microphone: 100 ohms
Sensitivity	Stereophone: 103dB SPL/1mW Microphone: -56dB +/- 3dB per 1V/ 1KHz; (-36dB +/- 3dB, V/Pa)
Distortion	Stereophone: <0.2%
Cord	Straight, Single Entry, 8ft or 2.4m
Plug	3.5 mm
Operating Range	100 – 16,000 Hz
Made in	China
Warranty	Lifetime

Address	KOSS Corporation 4129 North Port Washington Road Milwaukee, Wisconsin 53212
Website	www.koss.com

Appendix 10: Toshiba Laptop

These are the technical details concerning the laptop used in the research to save the recordings of all the informants.

Satellite A130-ST1311

Processor:	Processor Type * : Intel® Pentium® M Processor Number * : 430 Processor Speed * : 1.70GHz
Operating System	Genuine Windows XP Professional
Memory Size	512MB
Display Size	15.4" widescreen
Display Type	Widescreen XGA
Display Resolution	1280x800
Graphics Engine	Radeon® Xpress 200M
Graphics Memory	8MB-128MB dynamically allocated shared graphics memory
Hard Drive Size	60GB
Hard Drive Speed	5400rpm
Optical Drives	CD-RW/DVD-ROM
Wireless LAN	Atheros® Wireless LAN (802.11b/g)
Bluetooth	No Bluetooth (No Antenna)
Input Devices	85 key US keyboard, Hot Key Functions, Windows Key Function, TouchPad pointing device, CD/DVD Buttons, Application Launch Button
Security	Password Security, Security Cable Lock Slot, Hot Key Security
Modem	V.92 Modem
LAN	10/100
Audio	Standard stereo speakers, Headphone jack (stereo), Microphone jack (mono), Windows Sound System
AC Adapter	65W (19V 3.42A) Auto-sensing, 100-240V / 50-60Hz input
Battery Type	Li-Ion (2000mAh)
PC Card Slots	1-Type II PC Card Slot
PC Express Slot	No PC Express Slot
USB Slots	3-USB (2.0)
iLINK	i.LINK™ IEEE-1394
S-Video	TV-out (S Video)
Software	Microsoft Works, TOSHIBA ConfigFree®, TOSHIBA Disc Creator, TOSHIBA Game Console, Microsoft® Money 2007 Essentials, InterVideo® WinDVD®
Weight	Starting at 5.83 lbs.
Color	Mist Gray
Warranty	1-Yr Parts and Labor, 1-Year Battery

Appendix 11: Phonetic Keyboard

Phonetic Keyboard supplied online by UCL London
Unicode Phonetic Keyboard (UCL)
Phonetickbd102

1. The keyboard is designed to be an alternative layout for a UK English keyboard on Windows XP
2. You need to have Administrator privileges to install
3. Run the self-executable installer phonetickbd1*dd*.exe
4. After installation, switch to your normal user account.
5. Open Control Panel | Regional and Language Options
6. Select Languages tab
7. Choose Text Services and Input Languages | Details
8. Choose an input language of English (United Kingdom). You may need to first install support for UK English
9. Look at Installed Services, press Add
10. Choose Input Language: English (United Kingdom)
11. Check Keyboard layout/IME and select Unicode Phonetic Keyboard (UCL)
12. Click OK all the way out of the Regional and Language Options dialogue.

You may need to reboot for the keyboard to work correctly.

You should now have a keyboard icon in the language bar at the bottom right of the screen, and clicking this allows you to switch keyboards. The language bar also allows you to set up special key combinations to switch keyboards. For more help, seach for "language bar" under Start | Help and Support.

To remove the keyboard, first remove it from operation using Control Panel | Regional and Language Options, then as administrator remove the installed files using Control Panel | Add or Remove Programs.

Mark Huckvale
Phonetics & Linguistics
University College London
www.phon.ucl.ac.uk
m.huckvale@ucl.ac.uk

March 2006

Appendix 12: Increment Rate

1. The process of increasing in number, size, quantity, or extent.
2. Something added or gained: *a force swelled by increments from allied armies.*
3. A slight, often barely perceptible augmentation.
4. One of a series of regular additions or contributions: *accumulating a fund by increments.*
5. *Mathematics.* A small positive or negative change in the value of a variable.

INCREMENT RATE
The percentage by which a varying quantity increases or decreases between two of its stages.

1. The small quantity by which a variable increases or is increased.

DECREMENT

1. The act or process of decreasing or becoming gradually less.
2. The amount lost by gradual diminution or waste.
3. *Mathematics* The amount by which a variable is decreased; a negative increment.

Graphs : A Few More Samples

Some Tables

Points Outside The Scope of This Research

Limited to one sense group
RU5, Syl 5 is used and not more to stick to one sense group.
It is difficult to find more than five stressed syllables in one sense group
Limited to one intonational contour
Limited to five rhythm units

Calculation Booklet

People's Democratic Republic of Algeria
Ministry of Higher Education
University of Oran
Faculty of Arts and Foreign Languages
Department of English

Research on Rhythm
(Stress-Timing and Isochrony)
A Comparative Study
of Oran Teachers' and British Native Speakers' Realisations

Thesis Submitted to the English Department
in Partial Fulfilment of the Requirements for the Degree of Magister
in Phonetics and Linguistics

CALCULATIONS BOOKLET

By: Souhaila SENOUCI BEREKSI Supervisor: Prof. M. DEKKAK BELKHEIR

President of Jury: Prof. A.BOUAMRANE
Member of Jury: Dr A BAHOUS
Member of Jury: Mr R. BENALI

2007

Rough Data: Set One

DATA SET 1 RU	John	She left.	She's alone.	He is at work.
NAS1	0,358	0,608	0,667	0,686
NAS2	0,417	0,771	0,811	0,921
NAS3	0,289	0,508	0,613	0,622
NAS4	0,350	0,690	0,702	0,848

FAT01	0,420	0,808	0,748	0,851
FAT02	0,436	0,953	0,696	0,773
FAT03	0,390	0,759	0,727	0,781
FAT04	0,425	0,673	0,697	0,722
FAT05	0,420	0,760	0,762	0,694
FAT06	0,242	0,662	0,616	0,720
FAT07	0,380	0,695	0,641	0,701
FAT08	0,313	0,866	0,700	0,819
FAT09	0,366	0,846	0,692	0,779
FAT10	0,374	0,714	0,774	0,738
FAT11	0,275	0,636	0,657	0,622
FAT12	0,413	0,810	0,688	0,718
FAT13	0,860	0,657	0,700	0,799
FAT14	0,326	0,807	0,749	0,836
FAT15	0,399	0,649	0,682	0,705
FAT16	0,278	0,845	0,731	0,846
FAT17	0,303	0,630	0,648	0,663
FAT18	0,308	0,523	0,840	0,668
FAT19	0,235	0,806	0,769	1,240
FAT20	0,350	0,634	0,544	0,756
FAT21	0,424	0,863	0,928	0,973
FAT22	0,498	0,828	0,763	1,239
FAT23	0,291	0,731	0,651	0,549
FAT24	0,344	0,793	0,693	0,850
FAT25	0,312	0,709	0,661	0,962

MAT1	0,387	0,702	0,592	0,723
MAT2	0,290	0,717	0,629	0,584
MAT3	0,337	0,923	0,899	1,118
MAT4	0,374	0,656	0,786	0,820
MAT5	0,209	0,596	0,563	0,593

Rough Data: Set Two

	John Smith.	John and Ann.	I like it rare.	She's taking a bath	She's having her breakfast.	We listened to some music.
NAS1	0,683	0,623	0,799	1,063	1,065	1,084
NAS2	0,767	0,978	1,118	1,170	1,338	1,415
NAS3	0,581	0,739	0,712	0,905	1,074	1,094
NAS4	0,735	0,690	0,815	1,174	1,364	1,267

FAT01	0,735	0,812	0,978	1,070	1,421	1,478
FAT02	0,872	0,768	1,002	1,242	1,590	1,483
FAT03	0,925	0,846	0,908	1,047	1,188	1,514
FAT04	0,892	0,758	0,871	1,158	1,429	1,304
FAT05	0,867	0,880	0,951	1,150	1,508	1,409
FAT06	0,660	0,569	0,732	1,062	1,268	1,276
FAT07	0,860	0,771	0,911	1,116	1,512	1,569
FAT08	0,712	0,608	0,920	0,968	1,376	1,235
FAT09	0,853	0,673	0,845	1,081	1,272	1,429
FAT10	0,725	0,656	0,862	1,397	1,378	1,514
FAT11	0,733	0,644	0,983	1,135	1,387	1,311
FAT12	0,742	0,759	1,081	1,369	1,358	1,087
FAT13	0,741	1,027	0,951	1,087	1,337	1,248
FAT14	0,937	0,717	1,045	1,370	1,683	1,605
FAT15	0,724	0,616	0,782	1,200	1,362	1,222
FAT16	1,052	0,706	1,214	1,075	1,552	1,359
FAT17	0,723	0,561	0,715	1,022	1,460	1,266
FAT18	0,775	0,608	0,795	1,225	1,144	1,278
FAT19	0,844	0,696	1,009	1,245	1,525	1,570
FAT20	0,669	0,638	1,001	1,192	1,365	1,346
FAT21	0,846	0,746	1,255	1,422	1,515	1,726
FAT22	0,810	0,831	1,060	1,222	1,576	1,695
FAT23	0,899	0,881	0,782	0,868	1,150	1,354
FAT24	0,631	0,677	0,877	1,196	1,668	1,683
FAT25	0,843	0,688	0,917	1,121	1,288	1,394

MAT1	0,751	0,884	1,065	1,149	1,431	1,438
MAT2	0,742	0,562	0,743	1,082	1,228	1,120
MAT3	0,769	1,071	1,216	1,227	1,517	1,530
MAT4	0,868	0,763	0,875	1,183	1,293	1,174
MAT5	0,821	0,641	0,813	1,015	1,193	1,080

Rough Data: Set Three

	Ann left Bill.	He bought two cars.	It's raining too hard.	I have a lot to do.	I've never seen her dancing.	I saw the accident happen.
NAS1	0,721	0,969	1,074	0,861	1,224	1,174
NAS2	0,984	1,178	1,340	1,034	1,464	1,380
NAS3	1,072	0,981	1,086	0,952	1,110	1,223
NAS4	0,951	1,098	1,310	1,003	1,401	1,302

FAT01	0,918	1,274	1,363	1,066	1,566	1,339
FAT02	1,054	1,317	1,531	0,966	1,572	1,533
FAT03	0,895	1,083	1,165	0,936	1,445	1,235
FAT04	0,869	1,171	1,230	1,247	1,664	1,218
FAT05	1,018	1,129	1,253	1,319	1,577	1,414
FAT06	0,863	0,991	1,562	0,869	1,454	1,189
FAT07	0,888	1,112	1,153	1,170	1,556	1,588
FAT08	0,816	1,285	1,267	0,961	1,314	1,539
FAT09	0,858	0,956	1,036	0,984	1,473	1,309
FAT10	0,860	1,361	1,240	1,157	1,474	1,491
FAT11	0,953	1,143	1,241	1,147	1,533	1,326
FAT12	0,929	1,282	1,456	1,166	1,561	1,473
FAT13	0,883	1,494	1,318	1,107	1,347	1,613
FAT14	0,949	1,125	1,279	1,623	1,774	1,560
FAT15	0,802	1,072	1,173	0,931	1,347	1,465
FAT16	1,227	1,460	1,495	1,066	1,598	1,676
FAT17	0,704	0,983	1,005	0,841	1,354	1,167
FAT18	0,866	1,176	1,010	0,887	1,253	1,200
FAT19	1,104	1,212	1,265	1,138	1,627	1,384
FAT20	1,021	1,252	1,235	1,040	1,523	1,490
FAT21	1,001	1,502	1,633	1,465	2,022	1,962
FAT22	1,339	1,426	1,464	1,275	1,794	1,875
FAT23	0,977	1,039	0,980	0,875	1,497	1,330
FAT24	0,757	1,339	1,140	1,147	1,535	1,659
FAT25	0,866	1,215	1,250	1,091	1,357	1,372

MAT1	0,971	1,358	1,280	1,094	1,599	1,465
MAT2	0,667	0,974	0,855	0,893	1,246	1,004
MAT3	1,057	1,443	1,461	1,424	1,804	1,586
MAT4	0,986	1,200	1,329	0,984	1,304	1,306
MAT5	1,071	1,263	1,361	1,188	1,458	1,525

Rough Data: Set Four

	John left home late.	Bill shouts all the time.	She bought a new French car.	He likes horror films a lot.	I used to play tennis a lot.	I started drinking tea recently.	I fell in love with a beautiful girl.	I'm leaving on vacation next Saturday.
NAS1	1,056	1,053	1,287	1,413	1,296	1,598	1,459	1,594
NAS2	1,153	1,222	1,547	1,555	1,521	1,914	1,717	2,054
NAS3	1,121	1,226	1,262	1,390	1,200	1,433	1,719	1,676
NAS4	1,219	1,416	1,429	1,128	1,312	1,832	1,739	2,078
FAT01	1,301	1,506	1,609	1,619	1,682	2,342	1,753	2,033
FAT02	1,430	1,505	2,233	1,809	1,848	2,342	1,980	2,244
FAT03	1,574	1,281	1,335	1,716	1,647	1,864	1,970	2,391
FAT04	1,570	1,263	1,427	1,656	1,516	1,669	1,640	2,041
FAT05	1,372	1,386	1,466	1,622	1,584	1,871	1,788	1,930
FAT06	1,166	1,286	1,267	1,700	1,363	1,940	1,702	1,746
FAT07	1,327	1,431	1,499	1,795	1,855	2,318	2,144	2,202
FAT08	1,178	1,419	1,629	1,648	1,614	1,720	1,739	2,171
FAT09	1,326	1,144	1,289	1,452	1,517	1,867	1,829	1,837
FAT10	1,384	1,513	1,764	1,874	1,779	2,142	1,739	2,163
FAT11	1,308	1,359	1,531	1,627	1,713	2,158	1,942	2,697
FAT12	1,414	1,440	1,490	1,948	1,555	2,205	1,903	2,191
FAT13	1,193	1,674	1,916	1,357	1,645	2,375	1,694	2,894
FAT14	1,639	1,610	1,811	1,877	1,878	2,426	2,775	2,350
FAT15	1,149	1,839	1,520	1,729	1,555	2,118	2,199	2,034
FAT16	1,470	1,564	1,933	1,705	1,868	2,459	2,283	2,290
FAT17	1,077	1,433	1,587	1,499	1,735	2,023	2,058	1,791
FAT18	1,327	1,134	1,190	1,327	1,175	1,696	1,524	2,038
FAT19	1,594	1,382	1,833	1,807	1,717	2,611	1,993	2,688
FAT20	1,135	1,396	1,513	1,682	2,058	2,318	2,266	1,893
FAT21	1,613	1,613	1,605	2,013	1,893	2,593	2,393	2,406
FAT22	1,780	1,751	1,638	1,842	1,816	2,283	2,087	2,311
FAT23	1,405	1,340	1,284	1,620	1,638	2,279	1,716	2,153
FAT24	1,184	1,454	1,620	1,677	1,644	2,068	1,891	2,043
FAT25	1,315	1,176	1,562	1,666	1,789	1,985	2,044	1,972
MAT1	1,368	1,291	1,415	1,716	1,778	1,889	1,753	1,973
MAT2	1,030	0,873	1,147	1,219	1,729	1,532	1,473	1,712
MAT3	1,611	1,491	1,751	1,878	2,191	2,399	2,369	2,322
MAT4	1,134	1,084	1,256	1,471	1,552	1,804	1,872	1,914
MAT5	1,214	1,080	1,390	1,399	1,575	1,702	1,761	1,755

Rough Data: Set Five

DATA SET 5 RUs	John Smith Loves Ann White
NAS1	1,618
NAS2	1,547
NAS3	1,478
NAS4	1,528

FAT01	1,496
FAT02	2,301
FAT03	1,724
FAT04	1,727
FAT05	2,108
FAT06	2,273
FAT07	2,178
FAT08	1,817
FAT09	1,501
FAT10	2,122
FAT11	1,924
FAT12	2,210
FAT13	1,787
FAT14	1,943
FAT15	1,805
FAT16	2,172
FAT17	1,661
FAT18	1,921
FAT19	2,526
FAT20	2,307
FAT21	2,018
FAT22	2,375
FAT23	1,651
FAT24	1,688
FAT25	1,602

MAT1	2,049
MAT2	1,146
MAT3	1,978
MAT4	1,574
MAT5	1,572

Rough Data: The Rhyme

DATA	Rhyme Part 1	Rhyme Part 2	Rhyme Part 3	Rhyme Part 4	Rhyme Part 5
NAS1	1,145	2,657	3,168	3,974	5,843
NAS2	1,524	3,051	3,639	4,279	5,890
NAS3	1,399	3,453	4,370	5,445	7,427
NAS4	1,314	2,953	3,808	4,615	6,397
FAT01	1,464	3,777	5,060	6,562	7,713
FAT02	2,231	5,544	7,178	9,032	12,158
FAT03	1,993	4,327	5,361	6,971	10,095
FAT04	1,524	4,079	5,064	5,099	7,801
FAT05	1,771	3,851	4,452	5,998	7,989
FAT06	1,410	3,882	4,511	5,765	7,818
FAT07	1,499	3,821	5,457	5,850	9,444
FAT08	1,582	3,381	4,451	5,235	7,799
FAT09	1,610	3,373	4,133	4,921	6,720
FAT10	1,567	3,571	4,175	5,859	7,424
FAT11	1,650	3,910	5,350	6,785	9,048
FAT12	1,691	4,693	5,896	7,483	10,716
FAT13	1,532	3,782	5,238	6,551	9,493
FAT14	1,626	4,020	5,431	6,741	9,456
FAT15	1,620	4,377	5,564	6,661	9,275
FAT16	1,863	4,474	5,810	7,023	10,000
FAT17	1,668	4,472	6,252	7,197	10,123
FAT18	1,606	3,600	5,005	6,151	8,866
FAT19	1,966	3,767	4,872	5,030	6,662
FAT20	1,847	3,216	4,138	5,020	7,053
FAT21	1,831	3,772	4,959	6,170	8,310
FAT22	1,745	3,609	4,537	5,729	7,450
FAT23	1,852	3,695	4,694	6,137	8,201
FAT24	1,501	3,676	4,846	5,114	7,811
FAT25	1,898	3,409	4,487	5,237	7,432
MAT1	2,043	4,026	5,836	6,448	8,719
MAT2	1,332	3,174	3,857	5,668	6,961
MAT3	2,231	4,713	7,087	8,531	10,465
MAT4	1,863	3,641	4,336	5,276	6,816
MAT5	1,877	3,524	4,543	5,639	7,396

Ear Perception Analysis : Scores in Aphabetical Order

Chapter 3

Informant's Code	Score 1	Score 2	Score 3	Score 4	Score 5	Average
FAT01	3,00	2,00	3,00	3,00	3,00	2,80
FAT02	2,00	2,00	3,00	3,00	2,00	2,40
FAT03	1,00	2,00	1,00	2,00	2,00	1,60
FAT04	2,00	2,00	1,00	1,00	3,00	1,80
FAT05	3,00	3,00	3,00	4,00	3,00	3,20
FAT06	1,00	2,00	2,00	2,00	1,00	1,60
FAT07	3,00	3,00	3,00	3,00	3,00	3,00
FAT08	3,00	3,00	4,00	4,00	4,00	3,60
FAT09	3,00	4,00	4,00	3,00	3,00	3,40
FAT10	3,00	4,00	4,00	3,00	4,00	3,60
FAT11	3,00	3,00	3,00	3,00	4,00	3,20
FAT12	3,00	3,00	2,00	4,00	3,00	3,00
FAT13	3,00	3,00	3,00	3,00	3,00	3,00
FAT14	2,00	3,00	3,00	2,00	2,00	2,40
FAT15	2,00	3,00	3,00	3,00	3,00	2,80
FAT16	3,00	4,00	2,00	3,00	3,00	3,00
FAT17	2,00	3,00	3,00	3,00	3,00	2,80
FAT18	4,00	4,00	4,00	4,00	4,00	4,00
FAT19	4,00	4,00	3,00	3,00	3,00	3,40
FAT20	3,00	3,00	3,00	4,00	3,00	3,20
FAT21	3,00	3,00	3,00	4,00	3,00	3,20
FAT22	2,00	4,00	4,00	3,00	3,00	3,20
FAT23	2,00	2,00	1,00	3,00	2,00	2,00
FAT24	2,00	3,00	3,00	3,00	2,00	2,60
FAT25	4,00	4,00	4,00	4,00	4,00	4,00

MAT1	2,00	3,00	2,00	3,00	2,00	2,40
MAT2	3,00	3,00	3,00	2,00	3,00	2,80
MAT3	3,00	3,00	3,00	3,00	3,00	3,00
MAT4	4,00	4,00	4,00	4,00	4,00	4,00
MAT5	4,00	4,00	4,00	4,00	4,00	4,00

Ear Perception Analysis: Scores in Ascending Order

Chapter 3 Scores and Ranking in Ascending Order

Informant's Code	Score 1	Score 2	Score 3	Score 4	Score 5	Average
FAT03	1,00	2,00	1,00	2,00	2,00	1,60
FAT06	1,00	2,00	2,00	2,00	1,00	1,60
FAT04	2,00	2,00	1,00	1,00	3,00	1,80
FAT23	2,00	2,00	1,00	3,00	2,00	2,00
FAT02	2,00	2,00	3,00	3,00	2,00	2,40
FAT14	2,00	3,00	3,00	2,00	2,00	2,40
MAT1	2,00	3,00	2,00	3,00	2,00	2,40
FAT24	2,00	3,00	3,00	3,00	2,00	2,60
FAT01	3,00	2,00	3,00	3,00	3,00	2,80
FAT15	2,00	3,00	3,00	3,00	3,00	2,80
FAT17	2,00	3,00	3,00	3,00	3,00	2,80
MAT2	3,00	3,00	3,00	2,00	3,00	2,80
FAT07	3,00	3,00	3,00	3,00	3,00	3,00
FAT12	3,00	3,00	2,00	4,00	3,00	3,00
FAT13	3,00	3,00	3,00	3,00	3,00	3,00
FAT16	3,00	4,00	2,00	3,00	3,00	3,00
MAT3	3,00	3,00	3,00	3,00	3,00	3,00
FAT05	3,00	3,00	3,00	4,00	3,00	3,20
FAT11	3,00	3,00	3,00	3,00	4,00	3,20
FAT20	3,00	3,00	3,00	4,00	3,00	3,20
FAT21	3,00	3,00	3,00	4,00	3,00	3,20
FAT22	2,00	4,00	4,00	3,00	3,00	3,20
FAT09	3,00	4,00	4,00	3,00	3,00	3,40
FAT19	4,00	4,00	3,00	3,00	3,00	3,40
FAT08	3,00	3,00	4,00	4,00	4,00	3,60
FAT10	3,00	4,00	4,00	3,00	4,00	3,60
FAT18	4,00	4,00	4,00	4,00	4,00	4,00
FAT25	4,00	4,00	4,00	4,00	4,00	4,00
MAT4	4,00	4,00	4,00	4,00	4,00	4,00
MAT5	4,00	4,00	4,00	4,00	4,00	4,00

NAS Mean Durations & Increment Rates

Chapter 4: Operation 1

Set 1

	1_1	1_2	1_3	1_4
Mean Utterance Time	0,354	0,644	0,698	0,769
Mean Set Time	0,616			
Speakers Stand Dev	0,095			
Mean Utterance Increment		1,822	1,084	1,102
Mean Set Increment	1,252			

	2_2	2_3	2_4	2_5	2_6	2_7
Mean Utterance Time	0,692	0,758	0,861	1,078	1,210	1,215
Mean Set Time	0,969					
Speakers Stand Dev	0,127					
Mean Utterance Increment		1,095	1,137	1,252	1,123	1,004
Mean Set Increment	1,102					

Set 3

	3_3	3_4	3_5	3_6	3_7	3_8
Mean Utterance Time	0,932	1,057	1,203	0,963	1,300	1,270
Mean Set Time	1,121					
Speakers Stand Dev	0,102					
Mean Utterance Increment		1,134	1,138	0,800	1,350	0,977
Mean Set Increment	1,067					

Sets 4 and 5

	4_4	4_5	4_6	4_7	4_8	4_9	4_10	4_11	5_5
Mean Utterance Time	1,137	1,229	1,381	1,372	1,332	1,694	1,659	1,851	1,543
Mean Set Time	1,457								1,543
Speakers Stand Dev	0,114								0,058
Mean Utterance Increment		1,081	1,124	0,993	0,971	1,272	0,979	1,116	1,543
Mean Set Increment	1,067								1,446

FAT Mean Durations & Increment Rates

Chapter 4: Operation 1

Set 1

	1_1	1_2	1_3	1_4
Mean Utterance Time	0,375	0,746	0,710	0,800
Mean Set Time				0,658
Speakers Stand Dev				0,076
Mean Utterance Increment		1,989	0,952	1,127
Mean Set Increment				1,267

Set 2

	2_2	2_3	2_4	2_5	2_6	2_7
Mean Utterance Time	0,803	0,725	0,938	1,162	1,412	1,414
Mean Set Time						1,076
Speakers Stand Dev						0,086
Mean Utterance Increment	0,904		1,293	1,239	1,216	1,001
Mean Set Increment	1,109					

Set 3

	3_3	3_4	3_5	3_6	3_7	3_8
Mean Utterance Time	0,937	1,216	1,270	1,099	1,529	1,456
Mean Set Time	1,251					
Speakers Stand Dev	0,135					
Mean Utterance Increment	1,298		1,044	0,865	1,391	0,953
Mean Set Increment	1,092					

Sets 4 and 5

	4_4	4_5	4_6	4_7	4_8	4_9	4_10	4_11	5_5
Mean Utterance Time	1,369	1,436	1,582	1,691	1,683	2,147	1,962	2,180	1,953
Mean Set Time								1,756	1,953
Speakers Stand Dev								0,158	0,291
Mean Utterance Increment		1,049	1,102	1,069	0,996	1,275	0,914	1,111	1,953
Mean Set Increment								1,064	1,758

MAT Mean Durations & Increment Rates

Chapter 4: Operation 1

Set 1

	1_1	1_2	1_3	1_4
Mean Utterance Time	0,319	0,719	0,694	0,768
Mean Set Time	0,625			
Speakers Stand Dev	0,125			
Mean Utterance Increment	2,250		0,965	1,106
Mean Set Increment	1,331			

Set 2

	2_2	2_3	2_4	2_5	2_6	2_7
Mean Utterance Time	0,790	0,784	0,942	1,131	1,332	1,268
Mean Set Time	1,041					
Speakers Stand Dev	0,131					
Mean Utterance Increment	0,992		1,202	1,200	1,178	0,952
Mean Set Increment	1,087					

Set 3

	3_3	3_4	3_5	3_6	3_7	3_8
Mean Utterance Time	0,950	1,248	1,257	1,117	1,482	1,377
Mean Set Time	1,239					
Speakers Stand Dev	0,194					
Mean Utterance Increment	1,313		1,008	0,888	1,327	0,929
Mean Set Increment	1,078					

Sets 4 and 5

	4_4	4_5	4_6	4_7	4_8	4_9	4_10	4_11	5_5
Mean Utterance Time	1,271	1,164	1,392	1,537	1,765	1,865	1,846	1,935	1,664
Mean Set Time	1,597								1,664
Speakers Stand Dev	0,251								0,365
Mean Utterance Increment	0,915		1,196	1,104	1,149	1,057	0,989	1,049	1,664
Mean Set Increment	1,057								1,574

Mean Durations of 4 Selected Utterances
Chapter 4: Operation 2

	1_4	2_4	3_4	4_4	Overall Means
NAS1	0,686	0,799	0,969	1,056	
NAS2	0,921	1,118	1,178	1,153	
NAS3	0,622	0,712	0,981	1,121	
NAS4	0,848	0,815	1,098	1,219	
Mean	**0,769**	**0,861**	**1,057**	**1,137**	**0,956**
S. D.	**0,139**	**0,177**	**0,100**	**0,068**	**0,121**

FAT01	0,851	0,978	1,274	1,301	
FAT02	0,773	1,002	1,317	1,430	
FAT03	0,781	0,908	1,083	1,574	
FAT04	0,722	0,871	1,171	1,570	
FAT05	0,694	0,951	1,129	1,372	
FAT06	0,720	0,732	0,991	1,166	
FAT07	0,701	0,911	1,112	1,327	
FAT08	0,819	0,920	1,285	1,178	
FAT09	0,779	0,845	0,956	1,326	
FAT10	0,738	0,862	1,361	1,384	
FAT11	0,622	0,983	1,143	1,308	
FAT12	0,718	1,081	1,282	1,414	
FAT13	0,799	0,951	1,494	1,193	
FAT14	0,836	1,045	1,125	1,639	
FAT15	0,705	0,782	1,072	1,149	
FAT16	0,846	1,214	1,460	1,470	
FAT17	0,663	0,715	0,983	1,077	
FAT18	0,668	0,795	1,176	1,327	
FAT19	1,240	1,009	1,212	1,594	
FAT20	0,756	1,001	1,252	1,135	
FAT21	0,973	1,255	1,502	1,613	
FAT22	1,239	1,060	1,426	1,780	
FAT23	0,549	0,782	1,039	1,405	
FAT24	0,850	0,877	1,339	1,184	
FAT25	0,962	0,917	1,215	1,315	
Mean	**0,800**	**0,938**	**1,216**	**1,369**	**1,081**
S. D.	**0,163**	**0,133**	**0,158**	**0,183**	**0,159**

MAT1	0,723	1,065	1,358	1,368	
MAT2	0,584	0,743	0,974	1,030	
MAT3	1,118	1,216	1,443	1,611	
MAT4	0,820	0,875	1,200	1,134	
MAT5	0,593	0,813	1,263	1,214	
Mean	**0,768**	**0,942**	**1,248**	**1,271**	**1,057**
S. D.	**0,219**	**0,194**	**0,179**	**0,226**	**0,205**

Mean Increment Rates for Four Selected Utterances
Chapter 4: Operation 2

	1_4	**2_4**	**3_4**	**4_4**	**Overall Means**
NAS1	0,686	1,165	1,213	1,090	
NAS2	0,921	1,214	1,054	0,979	
NAS3	0,622	1,145	1,378	1,143	
NAS4	0,848	0,961	1,347	1,110	
Mean	**0,769**	**1,121**	**1,248**	**1,080**	**1,055**
S. D.	**0,139**	**0,111**	**0,148**	**0,071**	**0,117**

FAT01	0,851	1,149	1,303	1,021	
FAT02	0,773	1,296	1,314	1,086	
FAT03	0,781	1,163	1,193	1,453	
FAT04	0,722	1,206	1,344	1,341	
FAT05	0,694	1,370	1,187	1,215	
FAT06	0,720	1,017	1,354	1,177	
FAT07	0,701	1,300	1,221	1,193	
FAT08	0,819	1,123	1,397	0,917	
FAT09	0,779	1,085	1,131	1,387	
FAT10	0,738	1,168	1,579	1,017	
FAT11	0,622	1,580	1,163	1,144	
FAT12	0,718	1,506	1,186	1,103	
FAT13	0,799	1,190	1,571	0,799	
FAT14	0,836	1,250	1,077	1,457	
FAT15	0,705	1,109	1,371	1,072	
FAT16	0,846	1,435	1,203	1,007	
FAT17	0,663	1,078	1,375	1,096	
FAT18	0,668	1,190	1,479	1,128	
FAT19	1,240	0,814	1,201	1,315	
FAT20	0,756	1,324	1,251	0,907	
FAT21	0,973	1,290	1,197	1,074	
FAT22	1,239	0,856	1,345	1,248	
FAT23	0,549	1,424	1,329	1,352	
FAT24	0,850	1,032	1,527	0,884	
FAT25	0,962	0,953	1,325	1,082	
Mean	**0,800**	**1,196**	**1,305**	**1,139**	**1,110**
S. D.	**0,163**	**0,189**	**0,135**	**0,177**	**0,166**

MAT1	0,723	1,473	1,275	1,007	
MAT2	0,584	1,272	1,311	1,057	
MAT3	1,118	1,088	1,187	1,116	
MAT4	0,820	1,067	1,371	0,945	
MAT5	0,593	1,371	1,554	0,961	
Mean	**0,768**	**1,254**	**1,340**	**1,017**	**1,095**
S. D.	**0,219**	**0,176**	**0,137**	**0,071**	**0,151**

Individual Increment Deviations from the Norm
Chapter 4 Operation 2

	1_4	2_4	3_4	4_4	Overall Means
NAS Mean	**0,769**	**1,121**	**1,248**	**1,080**	**1,055**
NAS S. D					**0,117**

FAT01	0,082	0,028	0,055	-0,059	
FAT02	0,004	0,175	0,066	0,006	
FAT03	0,012	0,042	-0,055	0,373	
FAT04	-0,047	0,085	0,096	0,261	
FAT05	-0,075	0,249	-0,061	0,135	
FAT06	-0,049	-0,104	0,106	0,097	
FAT07	-0,068	0,179	-0,027	0,113	
FAT08	0,050	0,002	0,149	-0,163	
FAT09	0,010	-0,036	-0,117	0,307	
FAT10	-0,031	0,047	0,331	-0,063	
FAT11	-0,147	0,459	-0,085	0,064	
FAT12	-0,051	0,385	-0,062	0,023	
FAT13	0,030	0,069	0,323	-0,281	
FAT14	0,067	0,129	-0,171	0,377	
FAT15	-0,064	-0,012	0,123	-0,008	
FAT16	0,077	0,314	-0,045	-0,073	
FAT17	-0,106	-0,043	0,127	0,016	
FAT18	-0,101	0,069	0,231	0,048	
FAT19	0,471	-0,307	-0,047	0,235	
FAT20	-0,013	0,203	0,003	-0,173	
FAT21	0,204	0,169	-0,051	-0,006	
FAT22	0,470	-0,265	0,097	0,168	
FAT23	-0,220	0,303	0,081	0,272	
FAT24	0,081	-0,089	0,279	-0,196	
FAT25	0,193	-0,168	0,077	0,002	
FAT Mean	**0,031**	**0,075**	**0,057**	**0,059**	**0,056**
FAT S. D.	**0,163**	**0,189**	**0,135**	**0,177**	**0,166**

MAT1	-0,046	0,352	0,027	-0,073	
MAT2	-0,185	0,151	0,063	-0,023	
MAT3	0,349	-0,033	-0,061	0,036	
MAT4	0,051	-0,054	0,123	-0,135	
MAT5	-0,176	0,250	0,306	-0,119	
MAT Mean	**-0,001**	**0,133**	**0,092**	**-0,063**	**0,040**
MAT S. D	**0,219**	**0,176**	**0,137**	**0,071**	**0,151**

Duration of Stressed and Unstressed Syllables of Utterances in Set 1

Chapter 4 Operation

Utterance: 1RU_3Syl

	She's alone.	Duration of RU	Duration of Unstressed Syllables
NAS1	0,667	0,344	0,323
NAS2	0,811	0,436	0,375
NAS3	0,613	0,295	0,318
NAS4	0,702	0,316	0,386
	Mean	**0,348**	**0,351**
FAT01	0,748	0,301	0,447
FAT02	0,696	0,302	0,394
FAT03	0,727	0,312	0,415
FAT04	0,697	0,292	0,405
FAT05	0,762	0,390	0,372
FAT06	0,616	0,269	0,347
FAT07	0,641	0,272	0,369
FAT08	0,700	0,253	0,447
FAT09	0,692	0,326	0,366
FAT10	0,774	0,333	0,441
FAT11	0,657	0,301	0,356
FAT12	0,688	0,323	0,365
FAT13	0,700	0,346	0,354
FAT14	0,749	0,258	0,491
FAT15	0,682	0,330	0,352
FAT16	0,731	0,277	0,454
FAT17	0,648	0,283	0,365
FAT18	0,840	0,234	0,606
FAT19	0,769	0,181	0,588
FAT20	0,544	0,315	0,229
FAT21	0,928	0,373	0,555
FAT22	0,763	0,327	0,436
FAT23	0,651	0,250	0,401
FAT24	0,693	0,291	0,402
FAT25	0,661	0,360	0,301
	Mean	**0,300**	**0,410**
MAT1	0,592	0,377	0,215
MAT2	0,629	0,353	0,276
MAT3	0,899	0,458	0,441
MAT4	0,786	0,324	0,462
MAT5	0,563	0,254	0,309
	Mean	**0,353**	**0,341**

Utterance: 1RU_4Syl

	He is at work.	Duration of RU	Duration of Unstressed Syllables
NAS1	0,686	0,327	0,359
NAS2	0,921	0,429	0,492
NAS3	0,622	0,308	0,314
NAS4	0,848	0,385	0,463
	Mean	**0,362**	**0,407**
FAT01	0,851	0,389	0,462
FAT02	0,773	0,337	0,436
FAT03	0,781	0,322	0,459
FAT04	0,722	0,369	0,353
FAT05	0,694	0,275	0,419
FAT06	0,720	0,431	0,289
FAT07	0,701	0,352	0,349
FAT08	0,819	0,438	0,381
FAT09	0,779	0,370	0,409
FAT10	0,738	0,327	0,411
FAT11	0,622	0,342	0,280
FAT12	0,718	0,341	0,377
FAT13	0,799	0,366	0,433
FAT14	0,836	0,389	0,447
FAT15	0,705	0,347	0,358
FAT16	0,846	0,310	0,536
FAT17	0,663	0,283	0,380
FAT18	0,668	0,337	0,331
FAT19	1,240	0,404	0,836
FAT20	0,756	0,424	0,332
FAT21	0,973	0,386	0,587
FAT22	1,239	0,504	0,735
FAT23	0,549	0,294	0,255
FAT24	0,850	0,443	0,407
FAT25	0,962	0,520	0,442
	Mean	**0,372**	**0,428**
MAT1	0,723	0,407	0,316
MAT2	0,584	0,394	0,190
MAT3	1,118	0,423	0,695
MAT4	0,820	0,455	0,365
MAT5	0,593	0,458	0,135
	Mean	**0,427**	**0,340**

Duration of Stressed and Unstressed Syllables of Utterance in Set 2

Chapter 4 Operation 3: Utterance 2RUs_4Syl

	I like it rare.	like	rare	Duration of RUs	Duration of Unstressed Syllables
NAS1	0,799	0,155	0,312	0,467	0,332
NAS2	1,118	0,240	0,503	0,743	0,375
NAS3	0,712	0,136	0,276	0,412	0,300
NAS4	0,815	0,194	0,287	0,481	0,334
			Mean	**0,526**	**0,335**
FAT01	0,978	0,286	0,327	0,613	0,365
FAT02	1,002	0,244	0,301	0,545	0,457
FAT03	0,908	0,234	0,324	0,558	0,350
FAT04	0,871	0,197	0,283	0,480	0,391
FAT05	0,951	0,216	0,331	0,547	0,404
FAT06	0,732	0,204	0,293	0,497	0,235
FAT07	0,911	0,208	0,326	0,534	0,377
FAT08	0,920	0,185	0,356	0,541	0,379
FAT09	0,845	0,180	0,296	0,476	0,369
FAT10	0,862	0,201	0,272	0,473	0,389
FAT11	0,983	0,250	0,387	0,637	0,346
FAT12	1,081	0,247	0,368	0,615	0,466
FAT13	0,951	0,195	0,404	0,599	0,352
FAT14	1,045	0,242	0,323	0,565	0,480
FAT15	0,782	0,126	0,339	0,465	0,317
FAT16	1,214	0,228	0,400	0,628	0,586
FAT17	0,715	0,197	0,219	0,416	0,299
FAT18	0,795	0,244	0,418	0,662	0,133
FAT19	1,009	0,223	0,282	0,505	0,504
FAT20	1,001	0,258	0,353	0,611	0,390
FAT21	1,255	0,276	0,490	0,766	0,489
FAT22	1,060	0,261	0,295	0,556	0,504
FAT23	0,782	0,181	0,207	0,388	0,394
FAT24	0,877	0,204	0,294	0,498	0,379
FAT25	0,917	0,209	0,310	0,519	0,398
			Mean	**0,548**	**0,390**
MAT1	1,065	0,271	0,429	0,700	0,365
MAT2	0,743	0,156	0,347	0,503	0,240
MAT3	1,216	0,300	0,351	0,651	0,565
MAT4	0,875	0,204	0,353	0,557	0,318
MAT5	0,813	0,188	0,278	0,466	0,347
			Mean	**0,575**	**0,367**

Duration of Stressed and Unstressed Syllables of Utterance in Set 2

Chapter 4 Operation 3: Utterance 2RUs_5Syl

	She's taking a bath	tak	bath	Duration of RUs	Duration of Unstressed Syllables
NAS1	1,063	0,316	0,234	0,550	0,513
NAS2	1,170	0,424	0,257	0,681	0,489
NAS3	0,905	0,222	0,342	0,564	0,341
NAS4	1,174	0,324	0,456	0,780	0,394
			Mean	**0,644**	**0,434**
FAT01	1,070	0,292	0,324	0,616	0,454
FAT02	1,242	0,310	0,470	0,780	0,462
FAT03	1,047	0,290	0,328	0,618	0,429
FAT04	1,158	0,294	0,283	0,577	0,581
FAT05	1,150	0,322	0,356	0,678	0,472
FAT06	1,062	0,284	0,431	0,715	0,347
FAT07	1,116	0,282	0,356	0,638	0,478
FAT08	0,968	0,286	0,412	0,698	0,270
FAT09	1,081	0,234	0,359	0,593	0,488
FAT10	1,397	0,278	0,445	0,723	0,674
FAT11	1,135	0,320	0,374	0,694	0,441
FAT12	1,369	0,284	0,397	0,681	0,688
FAT13	1,087	0,288	0,420	0,708	0,379
FAT14	1,370	0,306	0,367	0,673	0,697
FAT15	1,200	0,222	0,502	0,724	0,476
FAT16	1,075	0,324	0,359	0,683	0,392
FAT17	1,022	0,224	0,357	0,581	0,441
FAT18	1,225	0,266	0,441	0,707	0,518
FAT19	1,245	0,360	0,380	0,740	0,505
FAT20	1,192	0,338	0,410	0,748	0,444
FAT21	1,422	0,464	0,459	0,923	0,499
FAT22	1,222	0,322	0,329	0,651	0,571
FAT23	0,868	0,164	0,200	0,364	0,504
FAT24	1,196	0,232	0,401	0,633	0,563
FAT25	1,121	0,354	0,405	0,759	0,362
			Mean	**0,676**	**0,485**
MAT1	1,149	0,398	0,400	0,798	0,351
MAT2	1,082	0,270	0,363	0,633	0,449
MAT3	1,227	0,306	0,378	0,684	0,543
MAT4	1,183	0,234	0,422	0,656	0,527
MAT5	1,015	0,236	0,438	0,674	0,341
			Mean	**0,689**	**0,442**

Duration of Stressed and Unstressed Syllables of Utterance in Set 3

Chapter 4 Operation 3: Utterance 3RUs_6Syl

	I have a lot to do.	have	lot	do	Duration of RUs	Duration of Unstressed Syllables
NAS1	0,861	0,128	0,145	0,205	0,478	0,383
NAS2	1,034	0,135	0,139	0,343	0,617	0,417
NAS3	0,952	0,129	0,186	0,250	0,565	0,387
NAS4	1,003	0,170	0,237	0,278	0,685	0,318
				Mean	**0,586**	**0,376**
FAT01	1,066	0,175	0,270	0,211	0,656	0,410
FAT02	0,966	0,113	0,218	0,295	0,626	0,340
FAT03	0,936	0,167	0,232	0,155	0,554	0,382
FAT04	1,247	0,276	0,247	0,373	0,896	0,351
FAT05	1,319	0,266	0,234	0,261	0,761	0,558
FAT06	0,869	0,144	0,198	0,252	0,594	0,275
FAT07	1,170	0,143	0,275	0,221	0,639	0,531
FAT08	0,961	0,153	0,275	0,131	0,559	0,402
FAT09	0,984	0,185	0,218	0,199	0,602	0,382
FAT10	1,157	0,178	0,238	0,363	0,779	0,378
FAT11	1,147	0,172	0,330	0,185	0,687	0,460
FAT12	1,166	0,192	0,279	0,224	0,695	0,471
FAT13	1,107	0,186	0,309	0,282	0,777	0,330
FAT14	1,623	0,298	0,259	0,254	0,811	0,812
FAT15	0,931	0,198	0,213	0,200	0,611	0,320
FAT16	1,066	0,125	0,241	0,218	0,584	0,482
FAT17	0,841	0,114	0,216	0,218	0,548	0,293
FAT18	0,887	0,131	0,276	0,180	0,587	0,300
FAT19	1,138	0,217	0,227	0,145	0,589	0,549
FAT20	1,040	0,141	0,208	0,362	0,711	0,329
FAT21	1,465	0,233	0,309	0,241	0,783	0,682
FAT22	1,275	0,139	0,287	0,188	0,614	0,661
FAT23	0,875	0,166	0,227	0,140	0,533	0,342
FAT24	1,147	0,160	0,255	0,204	0,619	0,528
FAT25	1,091	0,186	0,247	0,250	0,683	0,408
				Mean	**0,660**	**0,439**
MAT1	1,094	0,249	0,260	0,195	0,704	0,390
MAT2	0,893	0,161	0,188	0,204	0,553	0,340
MAT3	1,424	0,315	0,213	0,250	0,778	0,646
MAT4	0,984	0,165	0,241	0,241	0,647	0,337
MAT5	1,188	0,175	0,213	0,287	0,675	0,513
				Mean	**0,671**	**0,445**

Duration of Stressed and Unstressed Syllables of Utterance in Set 3

Chapter 4 Operation 3: Utterance 3RUs_7Syl

	I've never seen her dancing.	ne	seen	dan	Duration of RUs	Duration of Unstressed Syllables
NAS1	1,224	0,066	0,212	0,205	0,483	0,741
NAS2	1,464	0,106	0,259	0,218	0,583	0,881
NAS3	1,110	0,120	0,189	0,186	0,495	0,615
NAS4	1,401	0,191	0,215	0,235	0,641	0,760
				Mean	**0,551**	**0,749**
FAT01	1,566	0,161	0,255	0,191	0,607	0,959
FAT02	1,572	0,126	0,276	0,185	0,587	0,985
FAT03	1,445	0,104	0,238	0,192	0,534	0,911
FAT04	1,664	0,108	0,273	0,152	0,533	1,131
FAT05	1,577	0,122	0,295	0,158	0,575	1,002
FAT06	1,454	0,141	0,297	0,174	0,612	0,842
FAT07	1,556	0,152	0,264	0,167	0,583	0,973
FAT08	1,314	0,091	0,299	0,192	0,582	0,732
FAT09	1,473	0,087	0,296	0,182	0,565	0,908
FAT10	1,474	0,127	0,238	0,204	0,569	0,905
FAT11	1,533	0,097	0,225	0,172	0,494	1,039
FAT12	1,561	0,136	0,291	0,203	0,630	0,931
FAT13	1,347	0,146	0,248	0,201	0,595	0,752
FAT14	1,774	0,228	0,373	0,174	0,775	0,999
FAT15	1,347	0,198	0,213	0,200	0,506	0,841
FAT16	1,598	0,125	0,241	0,218	0,464	1,134
FAT17	1,354	0,114	0,216	0,218	0,459	0,895
FAT18	1,253	0,131	0,276	0,180	0,543	0,710
FAT19	1,627	0,217	0,227	0,145	0,546	1,081
FAT20	1,523	0,141	0,208	0,362	0,629	0,894
FAT21	2,022	0,233	0,309	0,241	0,666	1,356
FAT22	1,794	0,139	0,287	0,188	0,598	1,196
FAT23	1,497	0,166	0,227	0,140	0,589	0,908
FAT24	1,535	0,160	0,255	0,204	0,608	0,927
FAT25	1,357	0,104	0,287	0,219	0,610	0,747
				Mean	**0,578**	**0,950**
MAT1	1,599	0,141	0,304	0,242	0,687	0,912
MAT2	1,246	0,076	0,176	0,141	0,393	0,853
MAT3	1,804	0,122	0,369	0,228	0,719	1,085
MAT4	1,304	0,145	0,200	0,208	0,553	0,751
MAT5	1,458	0,085	0,321	0,203	0,609	0,849
				Mean	**0,592**	**0,890**

Duration of Stressed and Unstressed Syllables of Utterance in Set 4

Chapter 4 Operation 3: Utterance 4RUs_8Syl

	I used to play tennis a lot.	used	play	te	lot	Duration of RUs	Duration of Unstressed Syllables
NAS1	1,296	0,135	0,217	0,113	0,119	0,584	0,712
NAS2	1,521	0,201	0,211	0,163	0,374	0,949	0,572
NAS3	1,200	0,161	0,147	0,136	0,212	0,656	0,544
NAS4	1,312	0,176	0,109	0,112	0,233	0,630	0,682
					Mean	**0,705**	**0,628**
FAT01	1,682	0,278	0,310	0,110	0,202	0,900	0,782
FAT02	1,848	0,312	0,269	0,172	0,375	1,128	0,720
FAT03	1,647	0,132	0,168	0,153	0,337	0,790	0,857
FAT04	1,516	0,244	0,193	0,122	0,291	0,850	0,666
FAT05	1,584	0,288	0,177	0,123	0,329	0,917	0,667
FAT06	1,363	0,128	0,156	0,120	0,278	0,682	0,681
FAT07	1,855	0,347	0,236	0,100	0,331	1,014	0,841
FAT08	1,614	0,292	0,194	0,143	0,330	0,959	0,655
FAT09	1,517	0,277	0,161	0,124	0,357	0,919	0,598
FAT10	1,779	0,298	0,176	0,125	0,350	0,949	0,830
FAT11	1,713	0,280	0,199	0,178	0,318	0,975	0,738
FAT12	1,555	0,261	0,175	0,157	0,332	0,925	0,630
FAT13	1,645	0,284	0,172	0,112	0,325	0,893	0,752
FAT14	1,878	0,314	0,199	0,107	0,396	1,016	0,862
FAT15	1,555	0,223	0,253	0,127	0,312	0,915	0,640
FAT16	1,868	0,298	0,156	0,162	0,369	0,985	0,883
FAT17	1,735	0,294	0,293	0,165	0,321	1,073	0,662
FAT18	1,175	0,200	0,161	0,150	0,125	0,636	0,539
FAT19	1,717	0,182	0,220	0,163	0,323	0,888	0,829
FAT20	2,058	0,600	0,277	0,157	0,283	1,317	0,741
FAT21	1,893	0,287	0,231	0,136	0,434	1,088	0,805
FAT22	1,816	0,278	0,275	0,118	0,297	0,968	0,848
FAT23	1,638	0,231	0,191	0,159	0,369	0,950	0,688
FAT24	1,644	0,266	0,194	0,215	0,298	0,973	0,671
FAT25	1,789	0,302	0,221	0,167	0,371	1,061	0,728
					Mean	**0,951**	**0,733**
MAT1	1,778	0,283	0,183	0,153	0,382	1,001	0,777
MAT2	1,729	0,186	0,227	0,104	0,357	0,874	0,855
MAT3	2,191	0,335	0,227	0,152	0,386	1,100	1,091
MAT4	1,552	0,208	0,218	0,168	0,302	0,896	0,656
MAT5	1,575	0,203	0,198	0,193	0,324	0,918	0,657
					Mean	**0,958**	**0,807**

Duration of Stressed and Unstressed Syllables of Utterance in Set 4

Chapter 4 Operation 3: Utterance 4RUs_10Syl

	I fell in love with a beautiful girl.	fell	love	beau	girl	Duration of RUs	Duration of Unstressed Syllables
NAS1	1,459	0,134	0,222	0,141	0,306	0,803	0,656
NAS2	1,717	0,221	0,165	0,124	0,393	0,903	0,814
NAS3	1,719	0,197	0,233	0,124	0,329	0,883	0,836
NAS4	1,739	0,143	0,172	0,172	0,292	0,779	0,960
					Mean	**0,842**	**0,817**
FAT01	1,753	0,262	0,234	0,159	0,259	0,914	0,839
FAT02	1,980	0,300	0,246	0,186	0,315	1,047	0,933
FAT03	1,970	0,259	0,225	0,132	0,266	0,882	1,088
FAT04	1,640	0,189	0,197	0,175	0,241	0,802	0,838
FAT05	1,788	0,204	0,225	0,128	0,308	0,865	0,923
FAT06	1,702	0,184	0,193	0,105	0,272	0,754	0,948
FAT07	2,144	0 ,245	0,235	0,122	0,257	0,614	1,530
FAT08	1,739	0,224	0,195	0,161	0,229	0,809	0,930
FAT09	1,829	0,304	0,235	0,127	0,227	0,893	0,936
FAT10	1,739	0,269	0,193	0,171	0,306	0,939	0,800
FAT11	1,942	0,262	0,229	0,147	0,249	0,887	1,055
FAT12	1,903	0,154	0,223	0,200	0,303	0,880	1,023
FAT13	1,694	0,181	0,153	0,233	0,352	0,919	0,775
FAT14	2,775	0,345	0,357	0,220	0,298	1,220	1,555
FAT15	2,199	0,284	0,483	0,172	0,314	1,253	0,946
FAT16	2,283	0,296	0,313	0,179	0,322	1,110	1,173
FAT17	2,058	0,288	0,306	0,139	0,296	1,029	1,029
FAT18	1,524	0,171	0,218	0,134	0,284	0,807	0,717
FAT19	1,993	0,235	0,232	0,127	0,256	0,850	1,143
FAT20	2,266	0,273	0,224	0,237	0,332	1,066	1,200
FAT21	2,393	0,237	0,218	0,145	0,393	0,993	1,400
FAT22	2,087	0,197	0,253	0,097	0,260	0,807	1,280
FAT23	1,716	0,198	0,215	0,107	0,262	0,782	0,934
FAT24	1,891	0,197	0,180	0,177	0,276	0,830	1,061
FAT25	2,044	0,156	0,160	0,252	0,330	0,898	1,146
					Mean	**0,914**	**1,048**
MAT1	1,753	0,193	0,230	0,187	0,252	0,862	0,891
MAT2	1,473	0,159	0,159	0,112	0,290	0,720	0,753
MAT3	2,369	0,199	0,218	0,146	0,382	0,945	1,424
MAT4	1,872	0,152	0,207	0,167	0,330	0,856	1,016
MAT5	1,761	0,170	0,199	0,149	0,324	0,842	0,919
					Mean	**0,845**	**1,001**

Calculations Related to Duration in Stressed Syllable Utterances Only

Chapter 5 Operation 1

	DURATION					Mean Duration
Utterance	**1_1**	**2_2**	**3_3**	**4_4**	**5_5**	
NAS1	0,358	0,683	0,721	1,056	1,618	0,887
NAS2	0,417	0,767	0,984	1,153	1,547	0,974
NAS3	0,289	0,581	1,072	1,121	1,478	0,908
NAS4	0,350	0,735	0,951	1,219	1,528	0,957
Mean	**0,354**	**0,692**	**0,932**	**1,137**	**1,543**	**0,931**
S. D.	**0,052**	**0,081**	**0,150**	**0,068**	**0,058**	**0,082**
FAT01	0,420	0,735	0,918	1,301	1,496	0,974
FAT02	0,436	0,872	1,054	1,430	2,301	1,219
FAT03	0,390	0,925	0,895	1,574	1,724	1,102
FAT04	0,425	0,892	0,869	1,570	1,727	1,097
FAT05	0,420	0,867	1,018	1,372	2,108	1,157
FAT06	0,242	0,660	0,863	1,166	2,273	1,041
FAT07	0,380	0,860	0,888	1,327	2,178	1,127
FAT08	0,313	0,712	0,816	1,178	1,817	0,967
FAT09	0,366	0,853	0,858	1,326	1,501	0,981
FAT10	0,374	0,725	0,860	1,384	2,122	1,093
FAT11	0,275	0,733	0,953	1,308	1,924	1,039
FAT12	0,413	0,742	0,929	1,414	2,210	1,142
FAT13	0,860	0,741	0,883	1,193	1,787	1,093
FAT14	0,326	0,937	0,949	1,639	1,943	1,159
FAT15	0,399	0,724	0,802	1,149	1,805	0,976
FAT16	0,278	1,052	1,227	1,470	2,172	1,240
FAT17	0,303	0,723	0,704	1,077	1,661	0,894
FAT18	0,308	0,775	0,866	1,327	1,921	1,039
FAT19	0,235	0,844	1,104	1,594	2,526	1,261
FAT20	0,350	0,669	1,021	1,135	2,307	1,096
FAT21	0,424	0,846	1,001	1,613	2,018	1,180
FAT22	0,498	0,810	1,339	1,780	2,375	1,360
FAT23	0,291	0,899	0,977	1,405	1,651	1,045
FAT24	0,344	0,631	0,757	1,184	1,688	0,921
FAT25	0,312	0,843	0,866	1,315	1,602	0,988
Mean	**0,375**	**0,803**	**0,937**	**1,369**	**1,953**	**1,087**
S. D.	**0,121**	**0,101**	**0,139**	**0,183**	**0,291**	**0,167**
MAT1	0,387	0,751	0,971	1,368	2,049	1,105
MAT2	0,290	0,742	0,667	1,030	1,146	0,775
MAT3	0,337	0,769	1,057	1,611	1,978	1,150
MAT4	0,374	0,868	0,986	1,134	1,574	0,987
MAT5	0,209	0,821	1,071	1,214	1,572	0,977
Mean	**0,319**	**0,790**	**0,950**	**1,271**	**1,664**	**0,999**
S. D.	**0,072**	**0,053**	**0,164**	**0,226**	**0,365**	**0,176**

*Calculations Related to **Duration** in Stressed Syllable Utterances Only*

Chapter 5 Operation 1

	DURATION					Stress Duration per Speaker
	1_1	2_2	3_3	4_4	5_5	
NAS1	0,358	0,683	0,721	1,056	1,618	0,296
NAS2	0,417	0,767	0,984	1,153	1,547	0,325
NAS3	0,289	0,581	1,072	1,121	1,478	0,303
NAS4	0,350	0,735	0,951	1,219	1,528	0,319
Mean	**0,354**	**0,692**	**0,932**	**1,137**	**1,543**	**0,310**
S. D.	**0,052**	**0,081**	**0,150**	**0,068**	**0,058**	**0,013**
FAT01	0,420	0,735	0,918	1,301	1,496	0,325
FAT02	0,436	0,872	1,054	1,430	2,301	0,406
FAT03	0,390	0,925	0,895	1,574	1,724	0,367
FAT04	0,425	0,892	0,869	1,570	1,727	0,366
FAT05	0,420	0,867	1,018	1,372	2,108	0,386
FAT06	0,242	0,660	0,863	1,166	2,273	0,347
FAT07	0,380	0,860	0,888	1,327	2,178	0,376
FAT08	0,313	0,712	0,816	1,178	1,817	0,322
FAT09	0,366	0,853	0,858	1,326	1,501	0,327
FAT10	0,374	0,725	0,860	1,384	2,122	0,364
FAT11	0,275	0,733	0,953	1,308	1,924	0,346
FAT12	0,413	0,742	0,929	1,414	2,210	0,381
FAT13	0,860	0,741	0,883	1,193	1,787	0,364
FAT14	0,326	0,937	0,949	1,639	1,943	0,386
FAT15	0,399	0,724	0,802	1,149	1,805	0,325
FAT16	0,278	1,052	1,227	1,470	2,172	0,413
FAT17	0,303	0,723	0,704	1,077	1,661	0,298
FAT18	0,308	0,775	0,866	1,327	1,921	0,346
FAT19	0,235	0,844	1,104	1,594	2,526	0,420
FAT20	0,350	0,669	1,021	1,135	2,307	0,365
FAT21	0,424	0,846	1,001	1,613	2,018	0,393
FAT22	0,498	0,810	1,339	1,780	2,375	0,453
FAT23	0,291	0,899	0,977	1,405	1,651	0,348
FAT24	0,344	0,631	0,757	1,184	1,688	0,307
FAT25	0,312	0,843	0,866	1,315	1,602	0,329
Mean	**0,375**	**0,803**	**0,937**	**1,369**	**1,953**	**0,362**
S. D.	**0,121**	**0,101**	**0,139**	**0,183**	**0,291**	**0,037**
MAT1	0,387	0,751	0,971	1,368	2,049	0,368
MAT2	0,290	0,742	0,667	1,030	1,146	0,258
MAT3	0,337	0,769	1,057	1,611	1,978	0,383
MAT4	0,374	0,868	0,986	1,134	1,574	0,329
MAT5	0,209	0,821	1,071	1,214	1,572	0,326
Mean	**0,319**	**0,790**	**0,950**	**1,271**	**1,664**	**0,333**
S. D.	**0,072**	**0,053**	**0,164**	**0,226**	**0,365**	**0,049**

*Calculations Related to **Increment Rates** in Stressed Syllable Utterances Only*

Chapter 5 Operation 1

					Mean
	2_2	3_3	4_4	5_5	
NAS1	1,908	1,056	1,465	1,532	**1,490**
NAS2	1,839	1,283	1,172	1,342	**1,409**
NAS3	2,010	1,845	1,046	1,318	**1,555**
NAS4	2,100	1,294	1,282	1,253	**1,482**
Mean	**1,964**	**1,369**	**1,241**	**1,361**	**1,484**
S. D.	**0,115**	**0,336**	**0,178**	**0,120**	**0,187**

FAT01	1,750	1,249	1,417	1,150	**1,392**
FAT02	2,000	1,209	1,357	1,609	**1,544**
FAT03	2,372	0,968	1,759	1,095	**1,548**
FAT04	2,099	0,974	1,807	1,100	**1,495**
FAT05	2,064	1,174	1,348	1,536	**1,531**
FAT06	2,727	1,308	1,351	1,949	**1,834**
FAT07	2,263	1,033	1,494	1,641	**1,608**
FAT08	2,275	1,146	1,444	1,542	**1,602**
FAT09	2,331	1,006	1,545	1,132	**1,503**
FAT10	1,939	1,186	1,609	1,533	**1,567**
FAT11	2,665	1,300	1,373	1,471	**1,702**
FAT12	1,797	1,252	1,522	1,563	**1,533**
FAT13	0,862	1,192	1,351	1,498	**1,226**
FAT14	2,874	1,013	1,727	1,185	**1,700**
FAT15	1,815	1,108	1,433	1,571	**1,481**
FAT16	3,784	1,166	1,198	1,478	**1,907**
FAT17	2,386	0,974	1,530	1,542	**1,608**
FAT18	2,516	1,117	1,532	1,448	**1,653**
FAT19	3,591	1,308	1,444	1,585	**1,982**
FAT20	1,911	1,526	1,112	2,033	**1,645**
FAT21	1,995	1,183	1,611	1,251	**1,510**
FAT22	1,627	1,653	1,329	1,334	**1,486**
FAT23	3,089	1,087	1,438	1,175	**1,697**
FAT24	1,834	1,200	1,564	1,426	**1,506**
FAT25	2,702	1,027	1,518	1,218	**1,616**
Mean	**2,291**	**1,174**	**1,473**	**1,443**	**1,595**
S. D.	**0,628**	**0,165**	**0,161**	**0,243**	**0,299**

MAT1	1,941	1,293	1,409	1,498	**1,535**
MAT2	2,559	0,899	1,544	1,113	**1,529**
MAT3	2,282	1,375	1,524	1,228	**1,602**
MAT4	2,321	1,136	1,150	1,388	**1,499**
MAT5	3,928	1,305	1,134	1,295	**1,915**
Mean	**2,606**	**1,201**	**1,352**	**1,304**	**1,616**
S. D.	**0,771**	**0,190**	**0,199**	**0,148**	**0,327**

Analysis of Rhyme

Durations: Chapter 5 Operation 2

	Part 1	Part 2	Part 3	Part 4	Part 5	Overall Means
NAS1	1,145	2,657	3,168	3,974	5,843	
NAS2	1,524	3,051	3,639	4,279	5,890	
NAS3	1,399	3,453	4,370	5,445	7,427	
NAS4	1,314	2,953	3,808	4,615	6,397	
Mean Duration	**1,346**	**3,029**	**3,746**	**4,578**	**6,389**	**3,818**
Standard Deviation	**0,159**	**0,329**	**0,496**	**0,634**	**0,736**	**0,471**
FAT01	1,464	3,777	5,060	6,562	7,713	
FAT02	2,231	5,544	7,178	9,032	12,158	
FAT03	1,993	4,327	5,361	6,971	10,095	
FAT04	1,524	4,079	5,064	5,099	7,801	
FAT05	1,771	3,851	4,452	5,998	7,989	
FAT06	1,410	3,882	4,511	5,765	7,818	
FAT07	1,499	3,821	5,457	5,850	9,444	
FAT08	1,582	3,381	4,451	5,235	7,799	
FAT09	1,610	3,373	4,133	4,921	6,720	
FAT10	1,567	3,571	4,175	5,859	7,424	
FAT11	1,650	3,910	5,350	6,785	9,048	
FAT12	1,691	4,693	5,896	7,483	10,716	
FAT13	1,532	3,782	5,238	6,551	9,493	
FAT14	1,626	4,020	5,431	6,741	9,456	
FAT15	1,620	4,377	5,564	6,661	9,275	
FAT16	1,863	4,474	5,810	7,023	10,000	
FAT17	1,668	4,472	6,252	7,197	10,123	
FAT18	1,606	3,600	5,005	6,151	8,866	
FAT19	1,966	3,767	4,872	5,030	6,662	
FAT20	1,847	3,216	4,138	5,020	7,053	
FAT21	1,831	3,772	4,959	6,170	8,310	
FAT22	1,745	3,609	4,537	5,729	7,450	
FAT23	1,852	3,695	4,694	6,137	8,201	
FAT24	1,501	3,676	4,846	5,114	7,811	
FAT25	1,898	3,409	4,487	5,237	7,432	
Mean Duration	**1,702**	**3,923**	**5,077**	**6,173**	**8,594**	**5,094**
Standard Deviation	**0,195**	**0,506**	**0,715**	**0,965**	**1,358**	**0,748**
MAT1	2,043	4,026	5,836	6,448	8,719	
MAT2	1,332	3,174	3,857	5,668	6,961	
MAT3	2,231	4,713	7,087	8,531	10,465	
MAT4	1,863	3,641	4,336	5,276	6,816	
MAT5	1,877	3,524	4,543	5,639	7,396	
Mean Duration	**1,869**	**3,816**	**5,132**	**6,312**	**8,071**	**5,040**
Standard Deviation	**0,335**	**0,587**	**1,316**	**1,312**	**1,534**	**1,017**

Analysis of Rhyme

Increment Rates: Chapter 5 Operation 2

	Part 1	Part 2	Part 3	Part 4	Part 5	Overall Means
NAS1	1,145	2,657	3,168	3,974	5,843	
NAS2	1,524	3,051	3,639	4,279	5,890	
NAS3	1,399	3,453	4,370	5,445	7,427	
NAS4	1,314	2,953	3,808	4,615	6,397	
Mean Increment		**2,260**	**1,235**	**1,222**	**1,399**	**1,529**

FAT01	1,464	3,777	5,060	6,562	7,713	
FAT02	2,231	5,544	7,178	9,032	12,158	
FAT03	1,993	4,327	5,361	6,971	10,095	
FAT04	1,524	4,079	5,064	5,099	7,801	
FAT05	1,771	3,851	4,452	5,998	7,989	
FAT06	1,410	3,882	4,511	5,765	7,818	
FAT07	1,499	3,821	5,457	5,850	9,444	
FAT08	1,582	3,381	4,451	5,235	7,799	
FAT09	1,610	3,373	4,133	4,921	6,720	
FAT10	1,567	3,571	4,175	5,859	7,424	
FAT11	1,650	3,910	5,350	6,785	9,048	
FAT12	1,691	4,693	5,896	7,483	10,716	
FAT13	1,532	3,782	5,238	6,551	9,493	
FAT14	1,626	4,020	5,431	6,741	9,456	
FAT15	1,620	4,377	5,564	6,661	9,275	
FAT16	1,863	4,474	5,810	7,023	10,000	
FAT17	1,668	4,472	6,252	7,197	10,123	
FAT18	1,606	3,600	5,005	6,151	8,866	
FAT19	1,966	3,767	4,872	5,030	6,662	
FAT20	1,847	3,216	4,138	5,020	7,053	
FAT21	1,831	3,772	4,959	6,170	8,310	
FAT22	1,745	3,609	4,537	5,729	7,450	
FAT23	1,852	3,695	4,694	6,137	8,201	
FAT24	1,501	3,676	4,846	5,114	7,811	
FAT25	1,898	3,409	4,487	5,237	7,432	
Mean Increment		**2,322**	**1,294**	**1,217**	**1,395**	**1,557**

MAT1	2,043	4,026	5,836	6,448	8,719	
MAT2	1,332	3,174	3,857	5,668	6,961	
MAT3	2,231	4,713	7,087	8,531	10,465	
MAT4	1,863	3,641	4,336	5,276	6,816	
MAT5	1,877	3,524	4,543	5,639	7,396	
Mean Increment		**2,060**	**1,330**	**1,247**	**1,282**	**1,480**

Comparing 4RU_7Syl and Part 1 of Rhyme

Data Related to the Utterance : 4RU_7Syl

Chapter 5 – Operation 3

Informants	Duration	
NAS1	1,413	
NAS2	1,555	
NAS3	1,390	
NAS4	1,128	
Mean / Norm	**1,372**	
Standard Deviation	**0,178**	**Deviation from Mean**
FAT01	1,619	0,247
FAT02	1,809	0,437
FAT03	1,716	0,344
FAT04	1,656	0,284
FAT05	1,622	0,250
FAT06	1,700	0,328
FAT07	1,795	0,423
FAT08	1,648	0,276
FAT09	1,452	0,080
FAT10	1,874	0,502
FAT11	1,627	0,255
FAT12	1,948	0,576
FAT13	1,357	-0,015
FAT14	1,877	0,505
FAT15	1,729	0,357
FAT16	1,705	0,333
FAT17	1,499	0,127
FAT18	1,327	-0,045
FAT19	1,807	0,435
FAT20	1,682	0,310
FAT21	2,013	0,641
FAT22	1,842	0,470
FAT23	1,620	0,248
FAT24	1,677	0,305
FAT25	1,666	0,294
Mean	**1,691**	**0,319**
Standard Deviation	**0,166**	
MAT1	1,716	0,344
MAT2	1,219	-0,153
MAT3	1,878	0,506
MAT4	1,471	0,099
MAT5	1,399	0,027
Mean	**1,537**	**0,165**
Standard Deviation	**0,261**	

Comparing 4RU_7Syl and Part 1 of Rhyme

Data Related to the Part 1 of the Rhyme : 4RU_7Syl

Chapter 5 – Operation 3

Informants	Duration	
NAS1	1,145	
NAS2	1,524	
NAS3	1,399	
NAS4	1,314	
Mean / Norm:	**1,346**	
Standard Deviation:	**0,159**	**Deviation from Mean**
FAT01	1,464	0,118
FAT02	2,231	0,885
FAT03	1,993	0,647
FAT04	1,524	0,178
FAT05	1,771	0,425
FAT06	1,410	0,064
FAT07	1,499	0,153
FAT08	1,582	0,236
FAT09	1,610	0,264
FAT10	1,567	0,221
FAT11	1,650	0,304
FAT12	1,691	0,345
FAT13	1,532	0,186
FAT14	1,626	0,280
FAT15	1,620	0,274
FAT16	1,863	0,517
FAT17	1,668	0,322
FAT18	1,606	0,260
FAT19	1,966	0,620
FAT20	1,847	0,501
FAT21	1,831	0,485
FAT22	1,745	0,399
FAT23	1,852	0,506
FAT24	1,501	0,155
FAT25	1,898	0,552
Mean:	**1,702**	**0,356**
Standard Deviation:	**0,195**	
MAT1	2,043	0,697
MAT2	1,332	-0,014
MAT3	2,231	0,885
MAT4	1,863	0,517
MAT5	1,877	0,531
Mean:	**1,869**	**0,523**
Standard Deviation:	**0,335**	