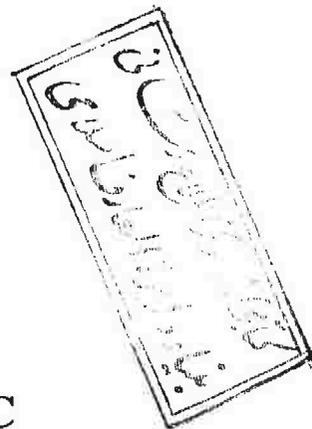# STRESS TIMING
IN MODERN LITERARY ARABIC

Mohamed H. HELIEL
University of Alexandria
Alexandria, EGYPT

Introduction

Rhythm, one of the important elements of the prosodic level of speech has not been studied in any detail in the literary variety of Arabic. Only one study has been devoted to the rhythm of one of the spoken varieties of Arabic, namely, Egyptian colloquial Arabic (Heliel, 1976). It is true that satisfactory research has been carried out in the area of word stress in the literary variety by English, Arab and other linguists (Lambert, 1897 ; Gairdner, 1925 ; Anis, 1947 ; Birkeland, 1954 ; Mitchell, 1960 and Abdo, 1969) but nothing much has been done on rhythm.

The term « stress-timing » as applied to English by Pike (1945) or « isochronism » as applied by Abercrombie (1965, 1967), means that the stresses mark off equal time periods. Some researchers (Shen / Peterson, 1962 ; Abe, 1967) tried to test isochronism of interstress intervals in English but have failed to find proofs of it in the material analyzed. The failure is mainly due to their inadequate conception of what stress timing can be. They could see strict **equality** or none. Strict equality has not been proved to be true of either stress-timed languages or syllable-timed ones (see O'Connor, 1965 and 1968 ; Lehiste, 1973 for stress-timed languages and Conzalez, 1970 for Tagalog which is assumed to be a syllable-timed language). The description of « tendency » toward isochronism in stress-timed languages is quite common. (Uldall, 1971 ; Patch, 1962). If isochrony is a « tendency » it will be our duty to look for this tendency to see how strong or how weak it is in Arabic, under what circumstances it can be realized and under what circumstances it can be obscured.

By listening to Arabic read aloud our intuition is that Arabic is stress-timed. In Arabic utterances, there exists some kind of periodicity which is indicated by landmarks or beats which produce an overall effect of regular rhythm, more prominent in poetry reading or speeches but varying in degree in stories read aloud, talks broadcast on the radio and radio dramas. In short phrases read by themselves, there can be no doubt of a stress that recurs with a certain degree of regularity. This regularity is not always achieved but rather approximated as to suggest an underlying order.

If temporal patterns between the stressed syllables are to be given more substance than an intuitive definition, the actual time periods between stresses, i.e., the rhythmic units must be measured.

Material

The material examined here consists of spectrograms of a recording of a short passage by the writer of this paper. The reading was in a moderately slow style. Later the text was divided into rhythmic units while listening to the tape recording. A rhythmic unit starts with a stress and contains everything that follows that stress up to, but not including, the next stress. The rhythmic unit, it has to be noted, is nongrammatical and non-lexical, and so does not bear any relation to word-integrity : its boundaries may split words, e.g., /« ˁaːlimun mu/ » fakkir (1)

Here we are concerned with « filled » rhythmic units only. The « partially filled » units which may occur initially or in the middle of speech after pause, e.g., Λ ʔ in/nahu (2) and « silent » ones occurring only in the middle, e.g., wa/ːa :limun mu/fakkir /Λ/ ʔallafal... are not measured though indicated.

Measurements

The measurements of rhythmic units start from the consonant starting the stressed syllable, the method adopted by O'Connor (1968) and Uldall (1971) in their testing of English rhythm. Such a method has also proved to be more satisfactory than measuring from the onset of the stressed syllable nucleus (Heliel, 1976).

In our measurements and fixing the boundaries of the rhythmic units we were guided by studies in the field such as Fant (1967) Jassem (1962) Peterson and Lehiste (1960) and Al-Ani (1970), and Heliel (1976).

In dividing the text into rhythmic units, i.e., units starting from one stress to the next, we did not distinguish between degrees of stress, primary, secondary and tertiary. Our belief is that what Arabic speakers single out are not so much degrees of stress as contrasts of stress, identifying pulses as strong or weak relative to neighbouring syllables. In the case of the experimenter who is analyzing his own native language, it is possible that the kinaesthetic factor which has been repeatedly referred to in the literature (Abe, 1967 ; Fry, 1958 ; Lieberman, 1968 ; Ladefoged, 1958), plays an important part in his judgements of the stresses he perceives. Thus it is here proposed to assume for stress a motor definition — rather than one based on an acoustic or auditory basis. Stress will be interpreted in kinaesthetic terms, i.e., in terms of the movements the hearer himself would make in order to produce the perceived effect. In our terminology, a stresse syllable is a syllable marked strong by the speaker /.listener (cf. Uldall, 1971). The stressed syllable will be hypothesized to be the one that provides the rhythmic beat in the utterance, that to which a native speaker of Arabic intuitively reacts. Our aim is to see whether there is a proof physically for the tendency to isochrony in modern literary Arabic read aloud with rhythmic units of different numbers of syllables, syllabic structure and segments. « Physical » time, it has to be noted, cannot be identical with « behavioural » time. However, it is important to see the relation between the two.

Text

The following is a phonetic transcription of the text examined with division into rhythmic units (filled, partially filled and silent), reference numbers of filled rhythmic units only are given above cach. Durations of the filled rhythmic units are given in centiseconds below each.

(1)	(2)	(3)	(4)	(5)	(6)
?in/nahu	?a/di:bun	ʕa/ði:m	/Λwa/ʕa:limun	mu/fakkir/ /	?allafal
———	72.00	52.00	92.00	68.80	84.80

(7)	(8)	(9)	(10)	(11)	(12)
ka/θi:ra	minal/kutubi	wal/qisas/	Λwa/lahu	fil/watanil	ʕara/biyy/Λ
101.60	72.00	67.20	80.80	84.00	32.00

(13)	(14)		(15)	(16)	(17)
/wafil	/xa:rig	/Λman/	zilatun	ʕa/ði:ma/Λ/	?inna ha/ya:tahu
36.80	48.00		76.00	36.80	80.00

(18)	(19)		(20)	(21)	(22) (23)
/qissatu	ki/fa:h	/Λwa/	gidd/Λwatu	mu:h/Λ/	kuffa basa/ruhu/
84.80	56.00		54.40	51.20	80.00 49.60

(24)	(25)	(26)	(27)		(28)	(29)
wahwa sa/ɣi:r	/Λha:/	sarahu	ðða/la:mu	min	kulli	ga:nib/Λ
62.4 48.00		84.00	73.60		46.40	43.20

(30)	(31)	(32) (33)	(34)
wa:ga/hathu	ðu/ru:fun	qa:/siyatun mu?/lima/Λ wa/	la:kinnahu
78.40		115.20 80.00 32.80	105.60

(35)	(36)	(37)		(38)	(39)
sta/ta:ʕa ?an ya/	šuqqa	ta/ri:qah	/Λ/	wastassi/	ʕa:bi/
100.00	73.60	40.00		76.00	48.00

(40)	(41)
wal	?a:/la:m
56.00	47.20

Durations

Table (1) shows the rhythmic units measured, their reference number, their content, syllabic structure, number of syllables and duration. The lines separating the rhythmic units indicate the presence of pauses.

As can be seen from the table, the passage contains 41 filled rhythmic units, all of which are measured except unit (1) where it was difficult to fix its beginning with any satisfactory degree of precision.

The mean duration, standard deviation and the ratio of standard deviation to the mean are also given.

Ref. No.	Rhythmic Unit	Syllabic Structure	No. of Syllables	Duration in C. secs
1	?in'hahu ?a		— — —	— — —
2	'di:bun 'a	CV:-CVC-CV	3	72.00
3	;i:m	CV:C	1	52.00
4	' a:limun mu	CV:-CV-CVC-CV	4	92.00
5	'fakkir	CVC-CVC	2	68.80
6	?allalal ka	CVC-CV-CVC-CV	4	84.80
7	'0i:ra minal	CV:-CV-CV-CVC	4	101.60
8	'kutubi wal	CV-CV-CV-CVC	4	72.00
9	'qisas	CV-CVC	2	67.20
10	'lahu lil	CV-CV-CVC	3	80.80
11	'watanil 'ara	CV-CV-CVC-CV-CV	5	84.00
12	'biyy	CVCC	1	32.00
13	'wafil	CV-CVC	2	36.80
14	'xa:rig	CV:-CVC	2	48.00
15	'zilatun 'a	CV-CV-CVC-CV	4	76.00
16	ĉi:ma	CV:-CV	2	36.80
17	ya:tahu	CV:-CV-CV	3	80.00
18	'qissatu ki	CVC-CV-CV-CV	4	84.80
19	'fa:n	CV:C	1	56.00
20	'gidd	CVCC	1	54.40
21	'mu:h	CV:C	1	51.20
22	'kuffa basa	CVC-CV-CV-CV	4	80.00
23	'ruhu	CV-CV	2	49.60
24	'wahwa sa	CVC-CV-CV	3	62.40
25	';i:r	CV:C	1	48.00
26	'sarahu ĉĉa	CV-CV-CVC-CV	4	84.00
27	'la:mu min	CV:-CV-CVC	3	73.60
28	'kulli	CVC-CV	2	46.40
29	'ga:nib	CV:-CVC	2	43.20
30	'hathu ĉu	CVC-CV-CV	3	78.40
31	'ru:fun qa:	CV:-CVC-CV:	3	115.20
32	'siyatun mu?	CV-CV-CVC-CVC	4	80.00
33	'lima	CV-CV	2	32.80

34	'la:kinnahusta	CV:-CVC-CV-CVC-CV	5	105.60
35	'ta:ʕa ʔanya	CV:-CV-CVC-CV	4	100.00
36	'suqqa ta	CV-CV-CV	3	73.60
37	'ri:qah	CV:-CVC	2	40.00
38	'wastässi	CVC-CVČ-CV	3	76.00
39	"a:bi	CV:-CV	2	48.00
40	'wal?a:	CVC-CV:	2	56.00
41	'la:m	CV:C	1	47.20

Mean Duration	66.78	
Standard deviation	21.28	
SD/MEAN	.31	

Table (1)

Duration of the rhythmic units in centiseconds, content of units, number of syllables and syllabic structure, separating lines indicate pauses, reference number of units in connected text.

Illustrative spectrograms of some of the rhythmic units in the text are shown in Figs. 1 to 4.

Table 2 shows the filled rhythmic units of the text arranged according to duration in centiseconds, duration increasing from top to bottom. These units are further divided into groups in relation to the median which is (70.40). The number of units in each group and the percentage of this number in relation to the total number of units measured are also indicated.

Our division into 3 groups is rather arbitrary and is meant to show the clustering of the durations around certain values and the degree of their approximation to or derivation from the median.

Group and range	Duration of filled rhyth- mic units in C. secs	Numbers of filled rhyth- mic units	Percentage in relation to the total number of units measured
1. From 32.00 to 56.00	32.00		
	32.80		
	36.80		
	36.80		
	40.00		
	43.20		
	46.40		
	47.20	15	37.5 %
	48.00		
	48.00		
	48.00		
	49.00		
	51.20		
	52.00		
	54.40		
2. From 56.00 to 84.80	56.00		
	56.00		
	62.40		
	67.20		
	68.80		
			Median 70.40 csec
	72.00		

Fig. 2   Rhythmic Unit No. 20

wa lg i   d d

Fig. 1 Rhythmic Units No. 6 and 7

wa t u'm u: ƕ
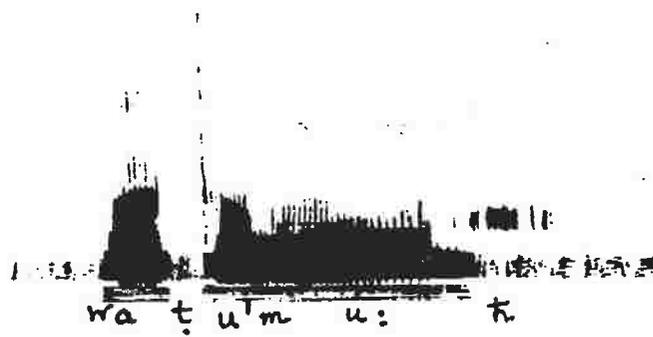
Fig. 3   Rhythmic Unit No. 21.

	72.00		
	73.00		
	73.60		
	76.00		
	76.01	20	50 %
	78.40		
	80.00		
	80.00		
	80.00		
	80.80		
	84.00		
	84.00		
	84.80		
3. From 92.00	92.00		
to 115.20	100.00		
	101.60	5	12.5 %
	105.60		
	115.20		

Table (2)

The filled rhythmic units of the text divided according to duration into 3 groups, the number of units in each group and its percentage to the total number of the units measured.

The filled rhythmic units in the text divide themselves into 1-, 2-, 3-, 4- and 5- syllable units (see Table 1). In Table 3 are shown the duration of each type of unit, mean duration, standard deviation, ratio of standard deviation to the mean and the ratio of the means.

Figure (5) represents the mean duration of 1-, 2-, 3-, 4- and 5- syllable units.

Discussion

1. From Table 1 it is clear that interstress times which correspond to rhythmic units vary in duration and that the variation is great. The duration of the shortest unit (Ho. 12) is 32.00 csecs. and the longest (No. 31) is 115.20 csecs. with the ratio of 1:3.6. The interstress times found in other stress-timed languages are also broad and so are the interstress times found in Egyptian colloquial Arabic. In English, Abe (1967) found interstress intervals in 'fast reading' ranging from 400 to 700 ms, Uldall's (1971, p. 206) measurements of a moderately slow reading style range from 260 to 870 ms and Patch's (1962, p. 50) measurements range from 300 to 900 ms. In Heliel's (1976) study of Egyptian Arabic spoken at normal speed, interstress intervals have been measured in two short stories read aloud and the measurements range from 300 to 1000 ms in one, and from 200 to 800 ms in the other.

It has to be noted that the preferred time between beats in music ranges from 200 to 900 ms (Fraisse, 1963). Thus the data avai lable about rhythm in English and our measurements of literary Arabic fit in well with the 0.2 to 1.0 range in motor rhythms (see Allen, 1968 who builds his conclusions on studies by Fraissee, 1963 and Woodrow, 1951), especially that of music.

As far as duration is concerned, the main disadvantage of using the range is that it depends on just the extreme score values which differ greatly from the other scores. We have to look into the successive rhythmic units for any tendency to isochrony.

2. Although we find scattered about the passage a number of successive rhythmic units of approximately the same duration (see units 10 and 11, 17 and 18, 19, 20, 21, 28 and 29, 34 and 35), there are varying degrees of duration differences between the other units 2 and 3 ; 4 and 5 ; 6, 7, 8 ; 11 and 12 ; 13 and 14). Thus when immediately successive intervals in Arabic are compared they show that the distribution of interstress intervals durations is broad. The same has been proved to be true of English (see Shen and Peterson, 1962 and Uldall, 1971, pp. 206-7) and Egyptian colloquial Arabic (Heliel, 1967, p. 343).
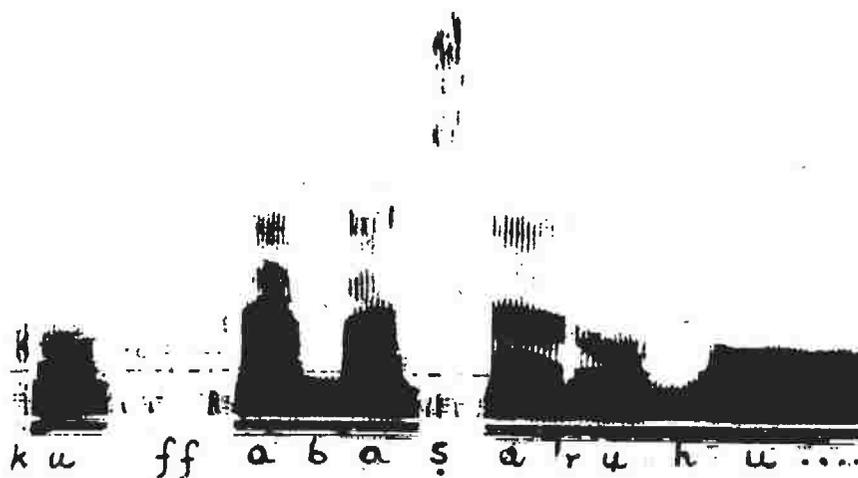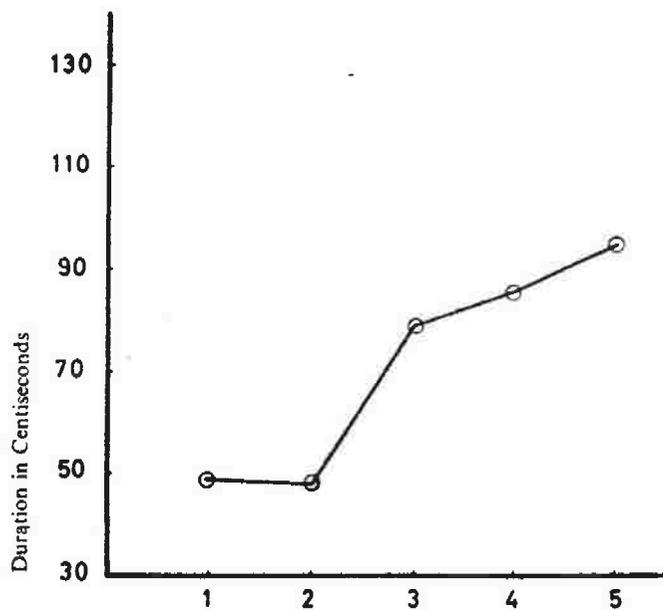
X

Fig. 4   Rhythmic Unit No. 22

Types of rhythmic unit (Number of Syllables)

Fig. 5   Mean Duration of 1-, 2-, 3-, 4- and 5- Syllable Rhythmic units

3. The tendency to isochrony among the consecutive rhythmic units taken as a whole is rather weak if we take SD as our criterion. The mean duration of all the units measured is 66.78 csecs, SD is 21.28 and the ratio of SD to the mean is 31.

To get a clearer picture of the tendency we counted the rhythmic units which actually fall within the range of ($\pm$). 31 from the mean. It was found that 27 units, nearly 67 % of the whole number of rhythmic units fall within this range. However, when we used the median as a means for testing the dispersion (see Table 2), we noticed that a large number of units cluster round the value of the median which is 70.4 csecs. If we took the range of clustering to be from 56.00 to 84.80 csecs those units would constitute nearly 50 % of the total number of units measured (see Table 2).

4. Since it is the relation between rhythmic units of varying numbers of syllables which is at issue in the concept of isochrony, we tried to see what relations hold between these units. From Table 3 it can be seen that the means of 1- and 2- syllable units show no appreciable difference ; they are nearly equal — but there is a much bigger difference in the duration of 3- syllable units as the ratios indicate.

Mean Duration Ratio of means (approximately)	1. syllable units		2. syllable units		3. syllable units
	48.68	:	47.80	:	79.11
	1.0	:	1.0	:	1.7
	5	:	5	:	8

However, there is a slight progression from 3- to 4- and from 4- to 5- syllable units.

Mean Duration Ratio of means (approximately)	3. syllable units		4. syllable units		5. syllable units
	79.11	:	85.52	:	94.80
	1.7	:	1.8	:	2
	8	:	·9	:	10

It is also to be noted that nearly (17.5 + 30) 47.5 % of the total number of rhythmic units are of 1- and 2- syllable units and (22.5 + 25) 47.5 % are of 3- and 4- syllable units.

5. We notice that the final rhythmic units before pause have a tendency to isochrony as is clear from their values (see Table 1), their mean which is 48.4 and SD which is 11.19 and the ratio of the SD to the mean which is 23. The following are the values of these units :

. 52.0/68.8/67.2/32.0/48.0/36.8/
56.0/54.4/51.2/48.0/43.2/32.8/
40.0/47.2/

Rhythmic units before pause are of one or two syllables. There is no appreciable difference between their mean durations.

	1. syllable units before pause	2. syllable units before pause
	52.0	68.8
	32.0	67.2
	56.0	48.0
	54.4	36.8
	51.2	43.2
	48.0	32.8
	47.2	40.0
Mean	48.68	48.11

Since, in Arabic, rhythmic units before pause are usually of one, two or three syllables at most (a constraint imposed by the occurrence of stress), these units prove to have a strong tendency to isochrony. This feature may be one of the factors that contribute to the sense of « regularity » in long stretches of speech. This tendency to isochrony may be rendered more prominent by the silent nature of the pause.

6. On the average, there is a tendency to isochrony between 1- and 2- and 3-, 4-, and 5- syllable units (5:5:8:9:10) but there are 1- syllable units which are longer than 2- syllable ones (see Table 1).

Ex. Unit (19) /faːh/   (1 - syllable)   56 csecs
        (14) /ˈxaːrig/ (2 - syllable) 48 csecs
and 3- syllable unit which are a bit longer than 4- syllable ones.

Ex. Unit (17) /ˈyaːtahu/   (3 syllables) 80 csecs
Ex.   (8) /ˈkutubi wal/   (4 syllables)   72 csecs

This indicates that though the number of syllables may be one of the constraints on the rhythmic unit duration, it is not the only one.

7. There is a tendency to isochrony between units of the same number of syllables and the same syllabic structure.

Table (3)

Duration of the different types of units (1-, 2-, 3-, 4- and 5- syllable units), mean duration standard deviation, ratio of standard deviation to the mean and ratio of the means.

Type of rhythmic Unit	1. Syllable	2. Syllable	3. Syllable	4. Syllable	5. Syllable
No. of Units	7	12	9	10	2
Percentage	17.5 %	30 %	22.5%	25 %	5 %
Duration in Centiseconds	52.00	68.80	72.00	92.00	105.60
	32.00	67.20	80.80	84.80	84.00
	56.00	36.80	80.00	101.60	
	54.40	48.00	62.40	72.00	
	51.20	36.80	73.60	84.00	
	48.00	49.60	78.40	76.00	
	47.20	46.40	115.20	84.80	
		43.20	73.60	80.00	
		32.80	76.00	80.00	
		40.00		100.00	
		56.00			
		48.00			
Mean	48.68	47.80	79.11	85.52	94.80
SD	8.00	11.43	14.61	9.70	15.27
SD/Mean	16	.23	.18	.11	.16
Ratio of the means	1.03	1.00	1.65	1.78	1.98
	5	5	8	9	10

1. syllable units (pausal)

Unit	(3)	/ðiːm/	(CV:C)	52.0	csecs
	(19)	/faːh/	(CV:C)	56.0	csecs
	(21)	/muːh/	(CV:C)	51.2	csecs
	(25)	/γiːr/	(CV:C)	48.0	csecs
	(41)	/laːm/	(CV:C)	47.2	csecs

XIII

2. syllable units (pausal)

Unit	(14)	/xa:rig/	(CV:-CVC)	48.0	csecs
	(29)	/ga:nib/	(CV:-CVC)	43.2	csecs
	(37)	/ri:qah/	(CV:-CVC)	40.0	csecs

3. syllable units (non-pausal)

Unit	(30)	/hat hu ʕu/	(CVC-CV-CV)	78.4	csecs
	(36)	/ɣuqqa ta/	(CVC-CV-CV)	73.6	csecs

4. syllable units (non-pausal)

Unit	(18)	/qissatu ki/	(CVC-CV-CV-CV)	84.8	csecs
	(22)	/kuffa basa/	(CVC-CV-CV-CV)	80.0	csecs
	(4)	/ʕa:limun mu/	(CV:-CV-CVC-CV)	92.0	csecs
	(35)	/ta:ʕa ʔanya/	(CV:-CV-CVC-CV)	100.0	csecs

This indicates that syllabic structure may be one of the constraints on the duration of the rhythmic unit.

8. The rhythmic units which are on the long end of the scale in their group (see Table 3) are found to include **long vowels** which may have increased their duration.

Examples

Reference Number	Rhythmic unit	No. of syllables	Duration in csecs	Duration of long vowel csecs	
(35)	/ta:ʕa ʔanya/	4	100	a	28
(7)	/θi:ra minal/	4	100.6	i :	29.6
(31)	/ru:funa:/	4	115.2	u:	27.2
				a:	26.4
(34)	/la:kinnahu sta/	5	105.6	a:	27.2

Conclusions

1. The interstress times in modern literary Arabic, as in other stress-timed languages vary widely. They fall within the range of 1:3.6.

2. The distribution of immediately successive interstress intervals duration is also broad. There are varying degrees of duration differences between these units.

3. On the average there is a strong tendency to isochrony between 1- and 2- syllable rhythmic units and a slight progression between 3-, 4- and 5- syllable units as the ratio of the means indicates 5:5:8:9:10.

4. Final rhythmic units before pause (of 1- and 2- syllables) have a strong tendency to isochrony. This may be one of the factors that contribute to the regularity of long stretches of speech in Arabic.

5. Three factors may affect the rhythmic unit duration :

a. Number of syllables
b. Syllabic structure
c. Vowel length.

Thus our results give us insight into the concept of « isochrony » which we may interpret as an « ideal ». The « tendency » to isochrony can be achieved with varying degrees depending on how near we come to fulfilling certain conditions such as comparable number of syllables and syllabic structure.

The duration of time-intervals which **tend** within their limits of structure to the mean of all rhythmic units — which may be regarded as a « norm» — is possibly what promotes in listeners, both native speakers and foreigners alike, a feeling of rhythmicalness about the language.

6. Our measurements of physical time in Arabic read aloud **partly** correspond with what we perceive, which leads us to conclude that isochrony or rather the **tendency** to it may be a characteristic of both production and perception. But how far we are capable of imposing temporal organization on speech durations so as to perceive patterns which might not exist in physical stimuli, is not known.

References

Abdo, D.A. (1969) **On Stress and Arabic Phonology : A Generative Approach.** Beirut : Khayats.

Abe, I. (1967) « English Sentence Rhythm and Synchronism ». **Bull. Phon. Soc. Japan.** 125 : 9 - 11.

Abercrombie, D. (1965).**Studies in Phonetics and Linguistics.** London : Oxford University Press.
(1967 **Elements of General Phonetics.** Edinburgh : Edinburgh University Press.

Al-Ani, S.H. (1970) **Arabic Phonology : An Accoustical and Physiological Investigation.** The Hague : Mouton.

Allen, G.D. (1967) « Two behavioural experiments on the location of the syllable beat in spoken American English » in **Studies in Language and Language Behaviour.** 4. : 2-179.
(1968) « The place of rhythm in a theory of language » in **Working Papers in Phonetics,** UCLA, Los Angeles. 10 : 60 - 84.

Anis, I (1947) **Al-Aswât al-Lughawiyya** (The Sound of Language). Cairo. Dâr-Nahda al-« Arabiyya Press.

Birkeland, H. (1954) **Stress Patterns in Arabic.** Oslo : Dybwad.

Catford, J.C. (1977) **Fundamental Problems in Phonetics.** Edinburgh : Edinburgh University Press.

Delattre, P.C. (1966) « A comparison of syllable length conditioning among languages » **IRAL** 3 : 183 - 198.

Fant, G. (1967) « Descriptive analysis of the acoustic aspects of speech » in **Readings in Acoustic Phonetics** ed. Ilse Lehiste, Cambridge, Massachusetts : MIT Press.

Fraisse, P. (1963) **The Psychology of Time.** New York : Harper and Row.

Fry, D.B. (1958) « Experiments in the perception of stress » in **Language and Speech.** 1 : 126 - 152.

Gairdner, W.H.T. (1925) **The Phonetics of Arabic** London : Oxford University Press.

Conzalez, A. (1970) « Acoustic correlates of accent, rhythm and intonation in Tagalog » **Phonetica** 22 : 11 - 14

Heliel, M.H. (1967) **The Rhythm of Colloquial Egyptian Arabic : An Experimental Study.** Unpublished Ph. D. Thesis, University College, London.

Jassem, W. (1962) « The acoustics of consonants » in **Proceedings of the Fourth International Congress of Phonetic Sciences,** pp. 50 - 72.

Ladefoged, P. (1971) **Preliminaries to Linguistic Phonetics.** Chicago and London : The University of Chicago Press.

Ladefoged, P., Draper, M.H. and Whitteridge, D. (1958) « Syllable and stress **Miscellanea Phonetica** 3 : 1- 14.

Lambert, M. (1897) « De l'accent en arabe » **Journal Asiatique** 10 : 402 - 413.

* Lieberman, P. (1968) « On the structure of prosody » **Zeit. Phon.** 21 : 129 - 34.

Mitchell, T.F. (1960) « Prominence and syllabication in Arabic » **BSOAS** 23 : 369 - 89.

Nasr, R.T. (1967) **The Structure of Arabic.** Beirut : Librairie du Liban.

O'Concer, J.D. (1965) « The perception of time-intervals » **Progress Report,** Phonetics Lab., University College, London.
(1968) « The duration of the foot in relation to the number of component sound segments » **Progress Report,** Phonetics Lab., University College, London.

Olsen, C.L. (1972) « Rhythmic patterns and syllabic features of the Spanish sense-group » in **Proceedings of the Seventh International Congress of Phonetic Sciences,** Montreal, pp. 990 - 997. The Hague : Mouton.

Patch, K. (1962) « Syllable Duration in Prose Read Aloud » Unpublished DAL dissertation, Edinburgh University.

Peterson, G.E., and Lehiste, I. (1960) « Duration of syllable nuclei in English JASA 32 : 693-703. Reprinted in Ilse Lehiste. (ed.) Readings in Acoustic Phonetics. Cambridge, Massachusetts : MIT

Pike, K. (1945) The Intonation of American English. Ann Arbor : University of Michigan Press.

Shen, Y. and Peterson. G.G. (1962) Isochronism in English, Studies in Linguistics. Occasional Papers 9. University of Buffalo.

Uldall, E.T. (1971) « Isochronous stresses in RP » in From and Substances : Phonetic and Linguistic Papers presented to Eli-Fischer Jorgensen (eds.) L.L. Hammerich, Roman Jakobson, Eberhard Zwirner. pp. 205-210. Denmark : Akademisk For lag.

Woodrow, W.H. (1951) « Time perception » in S.S. Strevens (ed.) Handbook of Experimental Psychology, pp. 1224-1236. New York : Wiley and Sons.

* **Abd alphabetically :**

Lehiste. I. (1973) « Rhythmic Units and Syntactic Units in production and perception ». JASA 54 : 1228-34.

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(1) The boundaries of rhythmic units are marked by a slash.

(2) A pause is marked by a caret Λ.