

?awta:r şawtijja
 maşal furdzal madgu:s
 Xalaş al panzi:n
 ħama:s fadi:d
 maşlafa qa:mma
 mara:dzii:fu mala:fi:b
 paşba:yu maşhi:q
 şad şadda:m
 şabaşal maşi:z
 na:tiq raşmi:
 ye:bu barad

?awta:r
 furs al madgu:s
 panzi:n
 ħama:s
 maşlaħa
 mara:dzii:hu
 masa:hi:q
 şad
 şabahal
 rasmi:
 ye:mu

APPENDIX 3

ERROR

sa:qi:l barid
 watadal be:n
 maşyu:l qala:ku:m
 mişja:r maqi:q
 ħa:latu əşahijja
 murtabat əbşawam
 ha:əa: se: qabi:l
 kullaf şabu:l

lajta zajtijja
 ?al maştu:ra maksu:ra
 dima:s zaka:?
 paşani:b ya:z
 maşfa:u maşta:
 mibra:du minfar

INTENDED UTTERANCE

sa:qi:
 sanadal be:t
 tu:l
 daqi:q
 şsiħhijja
 dawa:m
 dzami:l
 şabu:r

lawħa
 ?al maştara
 zakijja
 ?ana:bi:b
 maşi:fu maşta:
 mibradu minfar

APPENDIX 2
(Feature Errors)

ERROR

INTENDED UTTERANCE

muṣṭamska:t sahi:ha
 piṣṭiba:ra:t dza:nibijja.
 paṣna:d muma:θila
 piḍzciha:d tjaχsi:
 ma: ma:ṣ sajjā:rotu balmaṣrad
 da:ṣ bəkka:nu
 warədz du:ri
 da:r ṣammi:
 badχal duho:k
 naqid baḥri:
 ṣadi: fa:t bəl po:la
 qajaṣtaḷu:n bəl baṣta:n
 dru:z paḍabijja
 • Pittiha:d əl Pubada:ʔ
 paḍzaθrəθθa:ləθ
 paṣmida χafadijja
 muṣtamar sanawi:
 muvdi ddija:r
 maṭən maṣtu:b
 paṣəθ θa:hirijja
 murta:ṣ əl ba:l
 maṣru:ṣ baṣəθ
 ṣammat əṣṣaṣqa
 ṣaba:h'u' maṣa:ʔ
 masa:ṣi: ṣami:da
 de:s masku:n
 χubus ja:bəs

mustamsaka:t - - - -
 piṣṭiba:ra:t - - - -
 paṣda:d - - - -
 - - - - ṣaχsi:
 ma: ba:ṣ - - - -
 ba:ṣ dəkka:nu
 warəd dzu:ri:
 dza:r ṣammi:
 maḍχal - - - -
 naqal - - - -
 ṣali: fa:t bə po:da
 qajaṣtaḷu:n - - - -
 dru:s - - - -
 - - - - puḍaba:ʔ
 paḍdzaṣraθθa:ləθ
 - - - - χafabijja
 muṣtamar - - - -
 muṣti - - - -
 maṭən - - - -
 - - - - da:pi:rijja
 murta:h - - - -
 - - - - baḥəθ
 tammat - - - -
 - - - - masa:ʔ
 - - - - ḥami:da
 be:t - - - -
 χubuz - - - -

ERROR	INTENDED UTTERANCE
<p>fistaq sandzu:n masraf fata:t masdzu:l sale:ha: bala:midz musallija masa:fi wa:rifa fuhud faja:n maθwa:hul maXii:r mabla:f maYyu:m dzawari:b dzo:da Pannafi: walPistinfa:P Pawfida waSara:ji:n Palqa:b qiwa: warraha lil barra:d tašri:h al Pawraq Jatt al qo:ta:n Pidzma:f tamari:n Jawari:b qira:fi:ja Passabru mifta:h ul farah rafas al Putru:ha min Pašalha: nabi:b al muhami:n Ja:j se:la:n qalam dza:m taqam qatafa:t fad se:f ha:s mumaθθal qandi:l hadi:θ as:sa:ha sa:ra tšbi:ra Ja:jal XamJa Pašsa:n Paši:n</p>	<p>findaq sardzu:n masraf fata:t madzbu:r sale:ha bara:midz musallija mara:fi: wa:sifa fuhud faja:n maθwa:hul PaXii:r mablay maflu:m dzawari:b so:da annafi walPistinfa:m Pawrida waSara:ji:n Palqa:b qiwa: wadda:ha: lil barra:d tašhi:h al Pawraq Jadd al qo:ta:n Pidzra:P tamari:n qawari:b Sira:fi:ja ----- Faradz rafad al Putru:ha min Pašalha: naqib al muhami:n Ja:j se:lain qalam dza:f taqam qanafa:t fad se:f ha:r mumaθθa qadi:r hadi:θassa:fa sa:fa tšbi:ra Ja:jal Xasma ----- Paši:l</p>

APPENDIX 1

Phonemic Errors

ERROR	INTENDED UTTERANCE
<p> muntadzah dzami:l Pira:qa dawijja Pa:sa:sira sa:farat liffima:l massu: biPawqat sa:si:ba sa:t fa:lim ʕe:n wali: Xa:f sa:lta da:k bre:s tikkat sa:ʕa ʕalaqit to:pa qasat i:ssaq ka:sir u karim butam dal nati:dzta:l dzahi:θ darab kari:m ʕidra:k aš sa:fa:l ka:ʕi: farfu:ri: masfal al baladijja mustamar sanawi: ʕihka sa:hi:ka musaddabu mastu:r lahaq pazraq Pawra:m mubaʕθara Pima:lat al masa:p madzdi: ma:dzik kuhu:l muʕajjana sajja:qa:t qadi:ma warradz dzaga:ra sa:ru:dz muwadzdzah </p>	<p> muntazah dzami:l Pira:da qawijja Pa:l ʕa:Pila marru: biPawqat ʕa:si:ba fa:t sa:lom we:n ʕali: ʕa:f Xa:lta da:s bre:k sikkat sa:ʕa ʕalaqat so:pa qataʕa:ssat ja:saru karim butul dam nati:dzta:l baha:θ darab kari:m ʕidra:kat ta:fa:l ka:ʕi: farfu:ri: masfal al baladijja mustamar sanawi: ʕihka sa:xi:fa muPaddabu mastu:r lahab pazraq Pawra:q mubaʕθara Pisa:lat al ma:p madzdi: ma:lik ʕuju:n mukahhala sajja:ra:t qadi:ma warra:θ dzaga:ra saru:X muwadzdzah </p>

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This rather oversimplified model implies that units of speech production are hierarchical in size, the distinctive feature being the smallest. Furthermore, the scanning of the plan together with the retention of the elements of the plan in memory will be responsible for the appearance of both anticipatory and carryover processes which span the utterance as a whole.

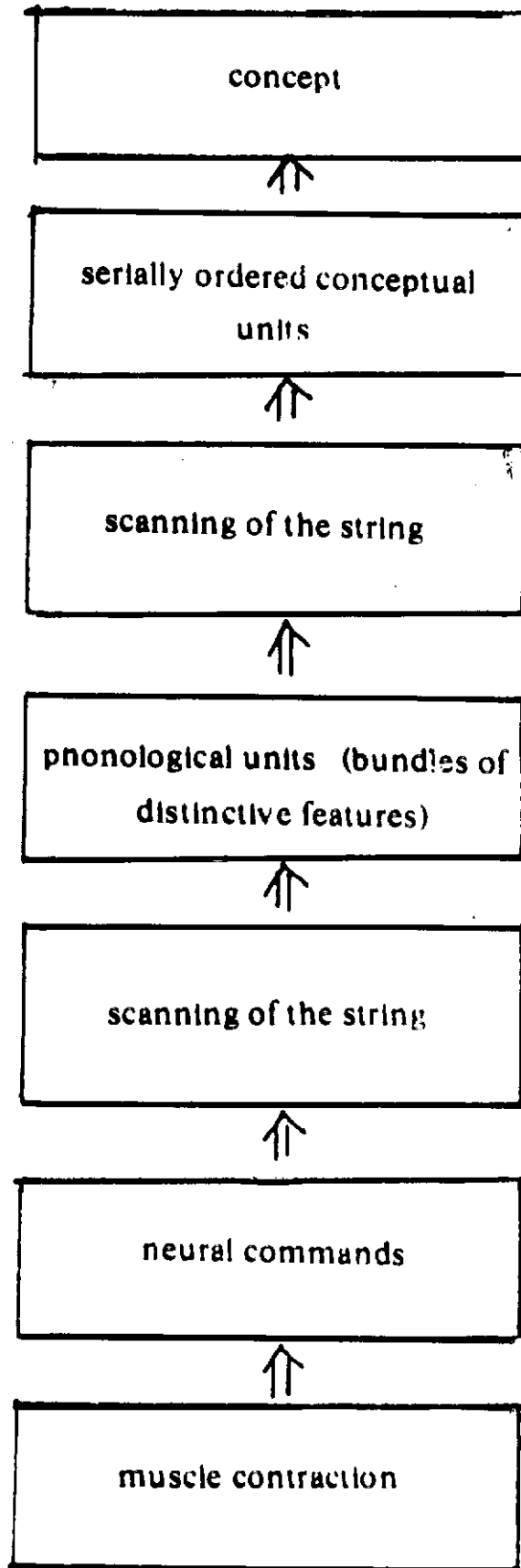
Conclusion:

This study has shown that speech errors involve words, syllables segments (i.e. phonemes) and features, which implies that they all exist as units of the speech production mechanism. Furthermore, position of the unit in the syllable rather than in the word seems to be of importance in speech errors.

Similarity of the neighbouring vowels is also of significance in exchange errors. Such errors occur in nasality, voicing, place, and manner of articulation. Similarity of the interchanged units does not appear to be a prerequisite for such exchanges.

Arabic is a language in which stress does not function contrastively at the lexical level. Thus exchange errors were not restricted by the position of the stressed syllable.

The findings of this study imply a hierarchical model of speech production whereby units of various sizes are represented, the feature being the smallest. Furthermore, the model is equipped with a scanning device which sweeps over the production programme and within a temporal window spanning the utterance as a whole.



adequate explanation of the context of the utterance. The errors in (19,21,22) and (23) might have been produced in the same manner, but without adequate knowledge about the background of these errors, any psychological explanation would be highly tentative.

Theories of speech production have generally stressed anticipatory processes (Of. Henke, 1966, Daniloff and Hammerberg 1973, Benguerel and Cowan, 1974 among others.) Such processes have generally been attested in this study. Indeed 58 % of the errors were those involving the replacement of one phonological unit by another occurring later in the utterance. Sometimes the anticipated unit was nine syllables ahead. This anticipation indicates a scanning device which scans the programme for the production of the utterance, and due to some disturbance, a future unit is anticipated early.

This, of course, does not mean that all errors are anticipatory. In fact 18 % of the errors were those of preservation, and 24 % involved both anticipatory and preservatory errors. Even those errors which have been labeled "anticipatory" can at the same time be viewed as involving preservation because an early unit which was replaced by a later one was also carried over sometimes to replace another occurring later in the utterance. This carryover process implies information storage which accompanies the scanning of the planned utterance; the scanning of the plan occurs prior to the conversion of abstract units into neural commands and muscular contractions. Thus at the time when the scanning device has swept over the plan for the utterance from its beginning to the end and back to the beginning again, the speech production mechanism has simultaneous access to all the phonological components of the utterance, and thus due to some malfunction in the device, early and late units get exchanged or shifted.

The findings reported above strongly imply a hierarchical model of speech production. The plan for the utterance first involves the utterance as a whole in the abstract (i.e. as a concept). In the next step this concept is represented as serially ordered units of the size of a word. The serially ordered units are scanned, and then in the third stage, they are converted into serially ordered phonological units (segments) each of which is realized as a bundle of distinctive features. Again these units are scanned, and then converted into neural commands to the muscles. This tentative model can be represented as follows:

It is not a unit in the stressed syllable which has been shifted or exchanged. In (16) the / d/ of the unstressed syllable has been anticipated; in (17) the feature {+ Delayed Release} has been carried over from an unstressed syllable, and in (18) the / d/ of a weakly stressed syllable has been carried over to a stressed one. This difference in the results could be due to the difference the languages involved. In both English and German stress is significant but it is not in Arabic, which may indicate that such phonological contrasts are specified in the plan for speech production.

The errors mentioned above are all phonologically possible; there were no errors that violated the phonological system of Arabic. However, there were two errors that involved the affricate / tʃ/. This sound does not exist in Standard Arabic, but it is found in some loan words in the dialect spoken in Mosul as well as in some other dialects spoken in central and southern parts of Iraq.

A careful examination of the data presented above reveals that the phonological context has a considerable effect on the structural appearance of the slips of the tongue. All the errors were exchanges or shifts of sounds already existing in the utterances. However, five errors (19- 23) are not motivated by the phonological context.

sa: qI: l bari: d (for: sa: ʕI: l bari: d) (19)

watad albe: n (for: sanad al be: t) (20)

maʃ u: l ʕala: tu: m (for: maʃ u: l ala: tu: l) (21)

ha:ʃ a ʃe: qabi: l (for: ha:ʃ a ʃe: dʒami: l) (22)

kulli ʃabu: l (for: kulli ʃabu: r) (23)

The appearance of / q/ in (19), of / k/ and / m/ in (21) and / q/ in (22) cannot be accounted for on the basis of phonological context. The conversion of / sanad/ into / watad/ in (20) and / sabu: r/ into / ʕabu: l/ in (23) are extreme cases. In (20) the error has led to a new lexical item which is meaningful in Arabic, and this in turn has been followed by a word partially resembling the intended word (i.e. / be: n/ for / be: t/) but drastically different from it semantically. The new utterance seems to express a totally opposite meaning. In (23) there seems to be a blend of two opposites (i.e. / sabu: r/ and / ʕadu: l). Such errors as these are psychologically revealing. The speaker who produced (20) was talking about a deceased man with whom he had had bitter family quarrels, and his true feelings betrayed him while trying to praise the man. Thus while trying to say that the deceased had been the "backbone" and the "pillar" of the family (/ sanad albe: t/), he actually said that the man had been a cause of "separation" and "quarrel" (/ watad albe: n/). This Freudian psychoanalysis is interesting and would be worth pursuing further if given

? aʕ na: d muma: ʕilla (for: ? aʕ dad.....) (7)

waridʒ du: ri: (for: warid dʒu ri:) (8)

matin maʕ tu: b (for: matin maʕ tu: b) (9)

duru: z adablɨja (for: duru: s ? adablɨja) (10)

masa: ʕ i: ʕ ami: da (for: masa: ʕ i: hami: ds) (11)

In (7), the feature [+Nasal] is added to [+Stop] and [+Coronal] is retained thus rendering [d] as [n]. In (8) the feature [+Delayed Release] is shifted to the word final [d] in / warid/ thus converting it into an affricate. The feature [+emphatic] is added to [t] in (9) which is rendered as [t]. Examples (10,11) involve the feature [+Voice], which, added to [s,h] changes them into [z] and [ʕ] respectively.

Contrary to what was found by MacKay (1970) for German the feature of place of articulation was quite common in my data. Of the thirty-three errors involving single features, ten (30%) involved exchanges in the place of articulation. Table 3 shows the percentages of the various features involved in the errors.

At this point it is worth pointing to a rather surprising result in this study. Previous investigators (e.g. Garret, 1980, Shattuck-Huffnagel, 1983, MacKay, 1970) have reported that similar units (i.e. units with similar feature specification) are exchanged, so that "a stop interchanged with other stops, fricatives with other fricatives, and semivowels with other semivowels" (MacKay, 1970: 332). The results of this study strongly run counter to the findings mentioned above. Though similar units were exchanged, there was a considerable number of interchanged segments which were widely different in their manner specification. Such cases can be illustrated by the following examples:

naqid bahri: (for: naqil bahri:) (12)

mustamar sanawi: (for: muʔ tamar sanawi:) (13)

de: s matku: n (for: be: t masku: n) (14)

ma al turdʒi l madʒu: s (for: ma a l furst l madʒu: s) (15)

In (12) a lateral is replaced by a stop; in (13) a glottal stop is replaced by a fricative; in (14) a stop and a fricative are exchanged, and in (15) a fricative is substituted by an affricate.

There is a further discrepancy between the results of my study and those obtained for other languages. Speech errors have been found to be affected by the degree of stress in that units in stressed syllables are antilepted or preserved (cf. MacKay, 1970). However, for Arabic as shown in this study, the effect of stress has not been systematic. in

da:ʕ bikka: nu (for: ba:ʕ dikka: nu) (16)

? idʕriha: d t ʕ axsi: (for: idʕriha: d ʕ axsi:) (17)

? aʕ midaxa ʕ adɨja (for: ? a midaxa ʕ abɨja) (18)

exchanged or shifted elements occupied different positions in the word as illustrated by the following:

- muntḏāh zaml: l (for: muntazah ḏzaml: l) (3)
 tikkat sa:ʕa (for: sikkat sa:ʕ a) (4)
 ʕalaqat tu: pa (for: ʕalaqat su: pa) (5)
 qaʃ at oʃʃ aq (for: qataʕ aʃʃ at) (6)

In (3) and (5) a word medial unit is exchanged with a word initial one; in (4) a word initial unit is replaced by another unit which is final in the same word; in (6) there are multiple exchanges: the word initial /q/ has replaced the word final /t/; also the medial /t/ in /qata / is replaced by the initial / / in / at/. In the present data, 26 % of the errors consisted in exchanging or shifting units belonging to different positions in the word. Thus we may conclude, at least for Arabic, that position in the syllable plays a more important role in phonological exchange errors than does position in the word.

Further consideration of the errors reported above raised the following question: Could the vocalic context have affected the exchange of sound units? An examination of the data revealed that 42 % of the exchanged units were preceded either by identical vowels or by vowels sharing similar degrees of height and opening. This finding again conforms to those made by MacKey (1970), which he found to support Wickelgren's (1969) associative chain model.

Table 3

Feature	Percentage
place	30 %
Manner	27 %
Voicing	25 %
Nasalization	11 %
other secondary features	7 %

Appendix 3 shows thirty-three (out of 110) errors all of which involve exchanges or shifts of single features. These cannot, in my view, be regarded as anything other than distinctive- feature errors. Shattuck-Huffnagel (1983) has argued against this view in her treatment of such errors in the MIT corpus, but errors in the present data do not seem to be explained otherwise. The following illustrative examples involve the change of one feature each, which is related to nasality, voicing, manner of articulation, or place of articulation.

Table 2

<u>Position</u>	<u>Percentage</u>
Syllable initial with syllable initial	47 %
Syllable medial with syllable medial	2 %
Syllable initial with syllable final	11 %
Syllable final with syllable final	25 %
Syllable final with syllable initial	15 %

for other languages. The tendency of syllable initial units to be exchanged with other syllable initial units is also consistent with findings for other languages (cf. Garret 1980: 184, MacKay, 1970: 336; see also Shattuck-Huffnagel, 1983).

Also prominently shown by Table 2 is the result that units occupying different positions in the syllable do not get exchanged as often as those occupying identical positions in the syllable. This finding lends some support to the view that the position of a unit in the syllable has a strong influence on the occurrence of exchange errors.

A major discrepancy between the present results and those reported by other investigators is related to the position of the exchanged unit in the word. Surveying the patterns of constraints on exchange errors reported by MacKay (1970), Fromkin (1971), Goldstein (1977), and Shattuck-Huffnagel and Klatt (1977), Garret (1980: 184) states:

The environment of "moved" elements (shifts, exchanges, anticipation, preservation) are similar: word initial segments exchange with (copy, or shift to) word initial segments, medial with medial, and final with final.

This neat classification according to environment in the word did not prove valid in the present study. Though position in the syllable seemed to determine, to a certain extent, the exchanges and shifts, position in the word did not seem to have such an effect. Indeed a considerable number of

In certain cases, the shift or exchange of a phoneme or a feature resulted in the appearance of a new lexical item which could be identified as an Arabic word but did not make sense in that particular context. I have called these "word errors" and have included them in the category of phonological errors

Table 1 shows the number of errors for each production unit together with their percentages calculated on the basis of all the data pooled together.

Table 1

<u>Type of Error</u>	<u>Number of Errors</u>	<u>Percentage</u>
phoneme	58	50 %
feature	38	33 %
syllable	8	7 %
word	11	10 %

Analysis of each error type mentioned in Table 1 reveals that the syllabic position of the exchanged unit plays a big role in the occurrence of the error. There was a strong tendency for a unit in syllable initial position to be shifted to or exchanged with another unit also initial in a syllable occurring either earlier or later in the utterance. It should be noted that in certain cases as in the erroneous utterance.

? Ira: qa dawilla (for ? Ira: da qawilla) (2)

one unit (/d/) is medial in the word and the other (/q) is initial in the word. However, as far as the syllable is concerned, both units are syllable initial (i.e. -da,qa-), and therefore such cases have been treated as belonging to syllable initial rather than to word initial position.

Similarly, there was a tendency for syllable final units to be exchanged with other syllable final units. Table 2 shows the percentages of exchange errors according to the position of the units in the syllable.

The above table shows that most of the errors belong to the initial position, followed next by those in the final position. In the medial position, however, the percentage was rather small and almost negligible. This could be explained with reference to results obtained by other investigators (cf. MacKay 1970: 336) which demonstrate that vowels are rarely exchanged. Since in the medial position we usually have vowels, then this negligible percentage in the present results conforms to the general pattern observed

Collection of the Data:

The speech errors reported in this paper were collected over a lengthy period of time amounting to five years. They were obtained from a variety of people belonging to different sexes and age groups. The following procedure was adopted systematically whenever an error was observed. The erroneous utterance was written down, and whenever possible, the context (linguistic and non-linguistic) of the error was established. Though unpopular, this method proved very helpful in analysing and explaining the error produced. Whenever the linguistic context provided no help, the person who produced the error was asked to explain what he/ she was thinking about when making the error. In such cases when the speaker was unwilling to reveal his/ her thoughts, information was elicited indirectly, which turned out to be useful in constructing the context.

Results and Discussion:

The errors observed could be classified into several categories, which can be reduced to three major ones: semantic, syntactic, and phonological errors. This order does not necessarily mean that semantic errors are predominant; in fact the last type (i.e. phonological errors) was the most frequent. However, it is my belief that the exclusion of semantic errors will leave a gap which cannot be accounted for when a model of speech production is attempted. Therefore, semantic considerations have been incorporated in this study though the main emphasis is on phonological aspects. Syntactic errors, on the other hand, need separate treatment, and thus fall out of the scope of this paper.

Phonological errors mainly consist in transposition, anticipation and preservation of sounds and sound sequences. The last two types also involve the omission and/ or addition of production units. These errors were first categorized according to the units exchanged or shifted. This was not, however, an easy task since in a large number of cases it was not possible to say whether it was one feature or a whole phoneme that was transposed or exchanged. For example in

da:ɣbikka: nu (for ba:ɣ dikka: nu) (1)

It is not clear whether it is the phoneme as a whole (i.e. /b/ into /d/) or just the feature of the place of articulation (i.e. [-Coronal + Anterior] into [+Coronal]) which has been exchanged. However, when more than one feature was exchanged or shifted, the error was taken to involve a phoneme, but when one feature was exchanged, the error was considered to be of a distinctive feature.

nature and magnitude of such units may be. The linguistic units (e.g. features, phonemes, syllables, words, phrases, clauses, and sentences) are units of competence, and as such, are discrete and timeless. These units, when transformed into physical/ physiological events (i.e. units of performance), acquire a further dimension, which is the dimension of time. Consequently, they fuse together and overlap to such an extent that it becomes impossible to find clear-cut boundaries between the units. To model speech performance, then, one has to look for the building blocks of speech.

Attempts at finding the units of speech production have in most cases been controversial. Kozhevnikov and Chistovich (1965) suggested the articulatory (CV) syllable, a unit which consists of a vowel preceded by whatever number of consonants irrespective of the word boundary.

In their definition of coarticulation, Daniloff and Hammerberg (1973) suggest the phoneme, or more accurately a "canonical" unit which is an uncoarticulated unit corresponding to a phoneme when "produced" in isolation (p. 241). Other studies similarly adopt the same unit (cf. Lindblom, 1963, MacKay, 1970).

However, due to coarticulation and contextual effects, it is not possible to find in actual performance units which can be identified as canonical forms. To avoid this problem, Wickelgren (1969) proposed the extrinsic allophone. In a string of phones, each phone is specified additionally for features belonging to the flanking phones.

Other researchers have opted for the feature as the basic unit of speech production. Henke (1966), Moll and Daniloff (1971), Benguerel and Cowan (1974), and Daniloff and Moll (1968) have all incorporated the feature in their models in an attempt to account for speech production and, more precisely, for anticipatory and carryover coarticulation.

This paper has a two-fold purpose. First it is an attempt to find psychological evidence of the units of speech production, and consequently to arrive at a certain model of speech production. Secondly, it is an attempt to find whether there is some sort of universality underlying the production of speech errors. This is done through the comparison of the present results with those obtained by others who have investigated speech errors in other languages. Furthermore this paper sought to find whether there are any regularities in the exchange of sounds and sound units. In particular, the position of the exchanged sounds and the direction of the exchange (i. e. anticipation or preservation) were given particular attention.

Slips of the Tongue : Evidence of a Hierarchical Model of Speech Production

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ABSTRACT

Research on speech programming has basically concentrated on the units of speech production. The phoneme has widely been claimed (Daniloff and Hammerberg, 1973 Mackay, 1970) and so have the allophone (Wickelgren, 1969) and the feature (Benguerel and Cowan, 1974, Henke, 1966). perceptually, the syllable has been emphasized (Studdert- Kennedy, 1976).

This controversial issue has been investigated in the context of slips of the tongue as produced by native speakers of Arabic of various ages and under different mental and physical conditions (anxiety, fear, illness and fatigue). Such speech errors mainly consist of transposition, addition, and omission of sounds and sound sequences.

Categorization of such speech errors shows that units of different magnitudes are involved. If we accept the view that such units enter into the programme for speech production, then we can conclude that the building blocks of the production plan are hierarchical with the feature being the smallest unit in the hierarchy.

The present investigation also shows that both anticipatory and carryover processes are involved in speech errors. A unit was either realized early in the utterance in anticipation of another occurring later, or carried over to replace a later unit, a finding which implies a scanning device which is equipped with a memory and sweeps over the plan within a temporal window spanning the utterance as a whole.

Introduction:

In a classic paper, Lindblom (1982) illustrated the lack of a one- to- one correspondence between linguistic and production units whatever the