TOWARDS A PHONOLOGY OF EGYPTIAN ENGLISH:
An Acoustic Comparison between Received Pronunciation and Egyptian English Vowels

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Abstract:

The purpose of this study is two fold: to investigate the acoustic properties of Egyptian English (EE) vowels in comparison with those of Received pronunciation (RP) and to explore some vowel-related phonological phenomena such as vowel reduction, insertion and disappearance. The analysis is based on the hypothesis that as English is used by non-natives, it is inevitably reconstructed and developed into autonomous "localized" varieties exhibiting phonological features, possessing representations and applying phonological rules of their own.. Thirteen randomly-selected Egyptian female English Department students and three RP female speakers reading two lists of words from Roach (1983) representing the English vowels were recorded. Using a speech analysis software, vowel formants frequencies (F1 and F2) and duration were calculated and data were labeled for vowel target position. For further comparative purposes, RP figures reported in a number of studies following the same procedure were given. EE speakers' reconstruction of RP vowels was found to be determined by such factors as: L1 influence, orthography, learners' self-consciousness, intrinsic phonological properties of the target vowel, and learner's attitude towards the target vowel. Results also demonstrate that EE vowels are generally fronter, lower, more spread and shorter than RP vowels. In line with impressionistic statements; EE /e/ and /i/ merge. Moreover, other

mergers, varying in the degree of merging, are /ɒ/ and /ʊ/ and /ʌ/ and /ɑ:/. Acoustic evidence shows a variability in the reconstruction of RP /3:/ to EE; being realized as /ʊ/+r, /i/+r and /e/+r. In sum, EE vowels inventory comprises only eight distinctive vowels :/i:/ (e/i), /æ/ (ʌ, ɑ:) (ɒ,ʊ), / ɔ:/, /u:/ and the variously reconstructed /3:/.

Results also uncover that EE, acting autonomously, applies a number of rules which may or may not be applied in RP. Among the rules unapplicable to EE are: vowel reduction, yielding [æ] bout, [ɒ] ppose, s[i]rvive, f[ɔ:]rget, etc.; and vowel disappearance yielding int[i]r∂stiŋ, nætʃ [u]r∂l, miz[i]r∂b∂l, etc. Among the phonological rules operative in EE are vowel insertion yielding [i]star, [i]student[i]s etc.; and vowel length whereby vowels are contrastively divisible into long and short. However, in EE vowels are not lengthened before voiceless consonants. Much work is to be done to explore other EE phonological features including diphthongs, consonants, stress and intonation before drawing conclusions on the nature of EE phonology.

Introduction:

The last two decades have witnessed considerable progress in the study of Non-Native Englishes (Hereafter NNEs). This has resulted from the wide-spread use of English worldwide. It is the native, official or co-official language of over 60 countries. Moreover, English has an increasing role to play in the rest of the countries. Being the language of international air traffic, most of scientific research, technology, business and trade, popular music, media, etc., English is regarded as a world language, which “achieves a genuinely global status when it develops a special role that is recognized in every country”. (Crystal, 1995: 106)

Given such a unique and unprecedented international status, Kachru (1982) proposes his world Englishes hypothesis which suggests that English as used internationally can be seen in terms of three major Circles: Inner, Outer and Expanding. In Inner-Circle countries, English is used as the native language such as in the UK and the US. In Outer Circle countries, English is used as the official or co-official language such as in India, and Nigeria. Finally, in Expending-Circle countries such as Brazil, China Japan and Egypt, English is used as a foreign language.

Such a global spread of English entails that most of the English speakers are not native; and that English is no longer belonging solely to Inner-Circle natives. Alatis (1990) maintains that being a global language English is localized i.e. colored by local overtones and idioms; and retains the local-speech rhythm, wherever used. This gives rise to lots of Englishes: natives and non-natives, where it is said that people speak Singapore English, Indian English, Pakistani English, etc….

It is commonly believed that Egypt falls in the Expanding Circle where English is a foreign language, and that there is no nativised variety of English of its own that serves both international and intranational functions. However, Schaub (2000: 225) contends that the fact that English serves as the first language of communication in such fields as medicine, higher education and tourism calls into question the notion of placing Egypt in the Expanding Circle. He argues that English in Egypt represents a unique example and calls for a reconsideration of the three major Circles. Further, he maintains that using English in such contexts makes it stand on equal footing with other varieties of world Englishes. Nevertheless, the question whether Egyptian English or English in Egypt is a distinctive variety or an interlanguage has not been fully addressed.

Interlanguage generally refers to a stage of second/foreign language acquisition where the learner's/speaker's English is commonly imperfect and incompetent (Askar 1998). It might be argued that the notion of interlanguage is used to describe the English of a specific stratum of Egyptians technically termed "mesolectals".

Mesthrie (2002) and Wissing (2002), among others, postulate that any non-native variety of English is a three-lect continuum of varying grammars, styles and abilities: basilect, mesolect and acrolect. Basilectals' English is commonly poor with frequent grammatical errors and exhibits a strong L1 influence. In Egypt, most individuals working with activities related to tourism would be basilectals. Acrolectals' English is fluent, very similar to the standard native varieties. Acrolectals, in Egypt, would be university lecturers, broadcasters, politicians, businessmen, medical specialists, graduates of senior language schools, graduates of foreign universities and some academic specialisations where English is the instruction medium, etc… In between lie the mesolectals with inter-mediate fluency, less competence, imperfect grammar, imperfect pronunciation, etc., features typically characterising an interlanguage. They include graduates of most public schools and universities[1]. Phonologically, several studies show that acrolectals' English differs slightly from the standard variety, whereas basilectals' English deviates considerably from the standard. As for mesolectals' English, it is nearer to the basilectals' than to the acrolectals' (Mesthrie 2002; Wissing 2002; among others).

It has long been argued that phonology comes first in detecting a given accent or variety. Numerous instrumental studies have tackled the phonetics and phonology of various NNEs, including Cameroon English

(Simo Bobda & Chumbow, 1999), Hong Kong English (Hung, 2000), Japanese & Korean Englishes (Ingram & Park, 1997), Malaysian English (Nair-Venugopal, 2000), Black South African English (Wissing, 2002), Tswana English (Van Rooy, 2002), Indian English (Pickering and Wiltshire, 2000) etc. Little is known about EE phonology though few impressionistic studies, prescriptively oriented, have made some claims about EE or English spoken by EF1 students. Ezzat (1973) points out that the lack of correlation between English orthography and pronunciation seems to be a key problem for foreign learners including Egyptians. Askar (1998) maintains that Egyptian EF1 students' interlanguage displays a number of error types including negative transfer errors, intralingual and developmental errors, errors due to intrinsic difficulty of target language sounds, among others. To Hung (2000: 337) the prescriptive approach, as it tackles the surface features, is not illuminating for it does not explain many confusing forms (e.g. net as /let/ and let as /net/). In other words, the possibility that /n/ and /l/ can have one/two underlying representation(s) does not concern the prescriptive approach. Alternatively, seen as features of an autonomous system, such confusions, among other "errors", would reflect the phonological conditions that trigger and "stimulate" them. Accordingly, some prescriptive traces and implications are undoubtedly unavoidable in any descriptive study of the phonology of a given NNE.

Munro's (1993) paper represents a major development in the study of the articulation of English vowels by native Arabic speakers. It provides an instrumental analysis of vowel formants and duration. However, the number of Egyptian subjects in the study sample, which is 23 native speakers of Arabic, is only "one" making it difficult to make claims and draw conclusions on EE acoustic properties. Furthermore, the analysis is limited to the study of surface differences without examining the underlying differences between the two systems.

The purpose of this study is two-fold: to investigate the acoustic properties of EE vowels [(1) first formant (F1), (2) second formant (F2) and (3) duration] in comparison with those of RP; and to explore, from a generative perspective, some vowel related phonological phenomena such as vowel reduction, insertion and disappearance in the two varieties. The analysis attempts an inventory of EE vowels. To achieve such a goal, it is no longer regarded satisfactory to provide an impressionistic articulatory description. For years, phoneticians tend to accord their sound description with mere articulatory factors. Clark and Yallop (1996) maintain that it has been discovered by means of X ray that vowel height is more determined by F1 frequencies than by tongue height. Features such as front vs. back which was commonly believed to result from tongue advancement can be specified by reference to the difference between F1 and F2 values. Acoustic measurements employed in this study serve to establish a description of EE vowels on objective, reliable bases.

Furthermore, the current study attempts to go beyond the limitations of the surface acoustic similarities and differences between RP and EE vowels by penetrating into their underlying representations through adopting the rule-and-derivation generative approach as introduced basically in Chomsky and Halle’s (1968) Sound Patterns of English (Hereafter SPE); and reviewed and explained by subsequent studies [e.g. Clark and Yallop, 1996; Mohnan, 1997; Cole, 1997, among others]. The generative approach seems instrumental in understanding the surface differences and deviations between NEs and NNEs.

This paper comprises four sections. Section one describes the procedures of subjects and material selection, material recordings, and target vowel acoustic labeling. Section two provides the theoretical premises on which data analysis and discussion are based. Section three gives an account of data analysis and results, supported by figures and tables. Section four sums up and discusses the findings obtained, and proposes some suggestions for further research.

1. Method:

1.1. Subjects:

EE speakers were 13 female English Department students at Tanta University: 5 from first, 4 from second and 4 from third years. Same-sex (female) speakers were chosen to avoid the influence of voice quality and properties of the fundamental frequency of the voices. All EE subjects were born and raised in Egypt, and were graduates of public schools. Consequently, they might be regarded as mesolectal to acrolectal speakers on the common NNEs continuum. It is commonly held that NNEs, being dynamic and unstatic, are related to the native varieties in the form of a continuum with one end representing the NNE and the other the native variety. NNEs speakers' proficiency level determines their place on such basilect, mesolect, acrolect continuum. Thus variability due to inter-speaker differences is inevitable in such studies, and is statistically handled by measuring the standard deviation (SD). RP speakers were 3 female junior staff members, Ibri Education College, Oman. As such, the number of RP subjects is remarkably small. Yet, it is statistically acceptable to compare a small sample with a large one. Moreover, additional figures for RP vowels from a number of studies (see Easton & Bauer 2000) were given. One study is Wells (1963). Its data, where all vowels were recorded in an /h-d/ frame, were collected from 25 male RP speakers reading isolated words. The same procedures were adopted in Deterding (1990) with 8 male and 8 female RP speakers.

Further, Deterding (1997) analysed vowel formants from a number of different words in a natural spoken context. The study sample consisted of 5 males and 5 females.

1.3. Recording:

Subjects were asked to provide their best production of every word. EE subjects were recorded in a quiet room digitized at 20 KHz. Recording lasted for two days, using a Shure 48 microphone and a Sony tape recorder. The material recorded was transferred to a log file. RP speakers were recorded in the same way by an assistant.

1.4. Labeling:

Once recording of the stimulus material was over, data were analysed to explore the acoustic measurements needed for the specification of each vowel. The spectrographic analysis was conducted automatically by using Dr Speech analysis software. Vowel labeling was made by measuring (F1 and F2 frequencies in Hz) and duration (in msec). F1 and F2 appear in the form of dark bands of concentrated energy at various frequencies (See Appendix). The acoustic onset of the vowel was marked at the onset of voicing shown by vertical lines, periodicity (- voice onset time) by wave forms; and where the aperiodicity (+ voice onset time) caused by aspiration has ended if the preceding consonant is a voiceless plosive. Thus the acoustic vowel target was marked as a single time point between the onset and the offset. For high vowels this point happened when F2 was at its highest; open vowels were identified when F1 was at its lowest; and target back vowels were marked by intermediate values of F2. F1 and F2 frequencies were measured by putting the cursor on the formant tracks. The acoustic offset of the target vowel was marked by vowel periodicity stoppage, a remarkable decrease in the amplitude of the waveforms, a sudden drop in the F1 frequency accompanied by disappearance of higher formants (F3 and F4), and the beginning of a silent interval (full details of vowel labeling are given in Munro, 1993, Watson *et al.*, 1998, among others).

Technically, there is an inverse relation between F1 frequencies and tongue height: the lower the F1 frequencies the higher the vowel and vice versa. A similar relation holds between F2 frequencies and tongue advancement: the higher the F2 frequencies the fronter the vowel and vice versa. The plotting of F1 frequencies on a vertical axis and F2 frequencies on a horizontal axis yields a shape identical to the usual vowel chart. Other vowel features such as roundness and tenseness/laxness were also detected and specified via F1 and F2 frequencies (see Table 1).

1.2. Material:

Roach's (1983) **English Phonetics and Phonology** word lists illustrating the twelve English monophthongs and written in standard orthography served as the study corpus. The words analysed from which vowels were extracted fell into two vowel-carrier lists. The words in the first list were monosyllabic where the influence of consonants was constrained. That list embraced 22 words whose nuclei represent all the 11 simple monophthongs, with each vowel being represented by two words: one ending in a voiced consonant; and the second in a voiceless one. The twelfth vowel /∂/ was represented in a list of disyllabic words. Their total number was 112. Thus, the total corpus consisted of 464 words. The total number of monosyllabic and disyllabic words was 352 and 112 respectively. Roach's corpus provides the most appropriate environments for measuring the target vowels with its minimization of possible effects such as (1) sentence structure, (2) stress and (3) intonation. This CVC frame proves quite effective in most acoustic studies (e.g. Munro 1993, Watson *et al.*, 1998, Easton and Bauer 2000, Hung 2000, Van Rooy 2002, and Wissing 2002).

2. Theoretical background

Recent developments in the study of the NNEs phonology have highlighted the assumption that they possess autonomous systems whose properties are different and sometimes similar to (NEs). The extent to which NNEs are similar to or different from NEs, and the diversions or deviations displayed are thought to be the product of a process of "restructuring", "reshaping", "reconstructing", among other similar terms, of NEs phonological forms administered by the NNEs (Simo Bobda & Chumbow 1999; Yung 2000; Van Roy 2000; Wissing 2002, among others).

The notion of "reconstructing" has been voiced and accounted for by a number of theoreticians in recent years. For natural phonologists, (e.g. Stampe, 1979; Donegan & Stampe, 1979; Dinnsen, 1979, 1999), "reconstructing" is an outcome of a host of "phonological processes" the child operates in his course of learning his mother tongue. To Stampe (1979: 1), a phonological process is "a mental operation that applies to speech to substitute, for a class of sounds or sound sequences presenting a specific common difficulty to the speech capacity of an individual, an alternative class identical but lacking the difficult property"(2). It is argued that the main purpose for operating such processes is to achieve two basic goals: articulatory ease and auditory distinctness. To this end, the phonological system is seen as a body of cognitive components interacting with each other in a continuous fashion. The outcome of such interaction is changing, and subject to the phonological processes which modify or reconstruct it constantly by setting rules substituting more convenient alternatives for problematic sounds or forms.

These processes may suppress or resist as the child language matures. For example, child acquiring a language where voiceless initial plosives are not aspirated will suppress his natural processes of non-aspiration so as to achieve mastery of aspirating voiceless plosives. On the contrary, for a child acquiring a language where aspiration is not a distinctive feature, this phonological process of aspirating plosives would continue or persist as an allophonic variation. Thus, forces of production/articulation and perception govern the operation, suppression and persistence of such natural processes in the context of phonological acquisition. Stampe's hypothesis is formulated as a contribution to phonological acquisition feeding directly into NNEs acquisition and learning, as the NNEs speakers employ the same processes to overcome articulatory problems facing them in their quest of learning English. They look for alternatives or substitutions free from the problematic feature which is difficult for them to learn at a particular stage of learning English.

The postulation that natural "reconstructing" processes, which are conditioned by forces of human vocalization and perception, apply to sound patterns evolution in languages is echoed and considerably accounted for by lexical phonologists, in basically diachronic studies (Kiparsky: 1997)[(3)]. Lexical phonologists' view of sound change i.e. "historical reconstructing" is best voiced by Kiparsky (1997: 642), sound change is:

> …. selectively integrated into the linguistic system and passed on to successive generations of speakers through language acquisition. This model makes sound change simultaneously mechanical on one level … yet structure-dependent on another.

Seen from this perspective, the acquisition of phonology is both natural/or mechanical and linguistically constrained. Kiparsky maintains that the learner, acquiring his mother language or learning a foreign one, “selectively intervenes” in the ambient data by “favoring” variants which enjoy articulatory ease; and at the same time are in line with the language system. Such forms are easy to learn. He postulates that this variation-and-selection procedure performed by the learner which represents his “reconstruction” of the data of the ambient language should be looked upon as a paradigm for historical linguistics (655).

Language acquisition theories provide deep insights in the understanding of the mechanisms a child or learner employs in processing the language input. The Maturation Hypothesis attributes language development to neurological maturation which makes new linguistic competence available. Maturation guides the child to determine which input data to deal with and focus on at which stage of language development. The Continuity Hypothesis assigns the constant instability characterizing child language to continuous restructuring/reconstructing of the child’s language-due to increases in child’s lexicon, memory size and processing capacities-once a new form is learned. The Modularity Hypothesis holds that the innate language-faculty modules, which act independly and sometimes collaboratively, are responsible for processing and representing a certain content domain (Bates, Bretherton & Snyder 1988). The independent operation of modules explains why the semantic module may operate and grow faster than both the syntactic and phonological ones. Likewise, Constructivism Theory of learning stresses the positive role of the learner, learning is regarded as a constructive act resulting from the interaction between the input and a group of such factors as background knowledge, experience, individual abilities and sociolinguistic factors (e.g. Foder, 1985; Ritchie & Bhatia, 1999; Wexler, 1999; Lust, 1999).

Following in language acquisition theorists' footsteps, L2 acquisition theorists emphasize the positive role the learner assumes in the learning process. The term interlanguage–which "roughly" refers to the autonomous linguistic system an L2 learner develops in the course of learning/acquisition, and which results from an interaction between linguistic properties of both the target and the native languages among other things-perfectly crystallizes the notion of "reconstruction". The constant process of "reconstruction" is responsible for branding interlanguage as instable, immature, incompetent, etc. The increasing recognition of interlanguage and the tendency to treat it as an autonomous, ever-changing system makes it justifiable to tackle its linguistic properties autonomously. "Errors" are not seen as problems in target language performance that reflect a sort of incompetence. Rather, they are viewed as features characterizing an independent language reflecting its own rules. In her review of literature on interlanguage, Askar (1998) maintains that second language acquisition/learning theorists, inspired by child language processes, emphasise the creative role of the learner, El-Daly (2000) stresses the same argument of highlighting the independent character of the interlanguage used by the L2 learner.

NEEs theorists go many steps further in the argument of the learner's reconstruction of native English data. As English is used by non-naives outside the Inner Circle, it is inevitably reconstructed and developed into autonomous "localized" varieties exhibiting linguistic features, possessing representations and applying rules of their own. The term “Englishes” materializes such a tendency motivating a fresh vision of the study of the newly-emerging English varieties. The study of phonology has been given special attention, since it is the phonological differences that help most in identifying a given English variety. (Most notable studies in this field are: Simo Bobda & Chumbow 1999, Van Rooy 2002, Hung 2000, Wissing 2002, among others).

Simo Bobda & Chumbow (1999) argue that the study of NNEs vowels, which has commonly been limited to vowel reduction, insertion, disappearance and substitution, falls in two directions. The first advocates a surface to surface comparison between NEs and NNEs. The second direction adopts an investigation of the underlying forms and the rules applied in generating the surface forms. Such a generative approach, according to Simo Bobda & Chumbow, must be preceded by a process of “restructuring” of the underlying NEs forms to underlying NNEs forms. Once such a process finishes, there should be two underlying representations: NEs and NNEs. This implies that NNE underlying form becomes independent. At this stage, the phonological rules typical of each “variety” operate to ultimately generate or derive the surface forms which may be similar to or different from those of the others. Simo Bobda & Chumbow term this approach “the trilateral process”.

In a similar spirit, Hung’s (2000: 338) investigation of Hong Kong English phonology rests on the assumption that there should be an in-depth phonological analysis of the underlying representations and “systematic phonological rules applying in an interlanguage-speaker’s phonological system”. Van Rooy (2002) and Wissing (2002) working on Black South African English assert approaching the different NNEs, whether interlanguages (in progress) or new varieties, on their own terms.

The process of “reconstructing” conducted by the child/the learner and diachronically through sound change is conducted in the light of a number of determining factors such as orthography, L1 influence, intrinsic phonological properties of the target phenomenon, familiarity of the target sound, learner’s self-consciousness, socio-linguistic attitude towards the foreign sounds, among others.

2.1. Reconstruction determining factors:

2.1.1. Orthography:

That there is a discrepancy between English pronunciation and spelling/orthography is widely emphasized. The Latin-based orthography of English is commonly criticized as it is not a neat representation of English sounds. This is manifested in the pains the English-speaking children take in learning orthography. Despite the historical efforts exerted by spelling reformers in standardizing “a single” orthographic form for a given word, much work is still to be done to make orthography a precise representation of sounds.

Orthography to the non-native speaker is a much severer problem. Simo Bobda & Chumbow neatly diagnose its causes saying:

> Although it may sound illogical to invoke orthography as a conditioning factor for phonological processes in the case of native speakers where the spoken form is acquired before the written form, it is agreed that this is valid in the case of non-native English where in the absence of native teachers as models, much of the language is learned from books, with the consequence that associations may be made with respect to the relation between certain graphemic units and

> their corresponding phonetic realizations. Such forms may be subsequently generalized to other acquirers (39).

Numerous studies on NNEs report systematic correspondence between pronunciation and letters, especially vowels. /∂/ represents the most frequent case, being pronounced systematically the way suggested by orthography in Nigerian, Cameroon and West African Englishes, (Simo Bobda & Chumbow, 1999). Likewise, MacCarthy (1978) reports similar cases in the English spoken by German, French and Spanish learners despite the fact that /∂/ is an attested vowel in their native languages. Additionally, Van Rooy (2002) points out that non-standard varieties of South African English pattern the same.

Still to base phonological analysis on orthography, though explicitly unfavored, seems to be possible. This is basically due to the strict and rigid conventions of English orthography. Gimson's trace of the historical sources of Present-day English phonemes is largely inspired by orthography. SPE dedicates a complete chapter highlighting a similar inspiration by orthography. The hub of Kiparsky's work on lexical phonology represents an obsession with historical sources and the processes of historical reconstructing of sounds guided primarily by orthography. Spelling defenders (see Baught and Cable 2002: 15), though acknowledging the chaotic character of the English orthography, emphasize that it is a useful tool in tracing word etymology. Additionally, elsewhere in generative phonological theory, there has been a tacit correlation between underlying phonological forms and orthography.

It is no wonder, therefore, for the foreign learner, where orthography is a prime asset for him, to draw heavily on it in pronunciation. It might be hypothesised, in this regard, that as NNEs represent a new stage in the historical development of the English language, fundamentally motivated by “a justifiable” correlation between orthography and pronunciation, similar to native English in earlier stages of its history, they would undergo similar/different sound change in the future. Given the increasingly autonomous character of these varieties, the prospective change would/would not pattern the same as NEs. Yet, the change processes would indispensably be conditioned by inter and intra-variety factors.

2.1.2. L1 influence:

That L1 influences L2 pronunciation accuracy is an unquestionable fact. It is commonly held that L1 influence increases when the learner starts learning an L2 after the Critical Period[4]. Flege *et al.* (1997: 170) review a host of studies which conclude that foreign accent is clearly and strongly manifested in the L2 pronunciation by learners starting learning English at the age of twelve; less clearly demonstrated when learning begins between the ages of 6 and 12; and totally absent if L2 learning opens at the age of seven. Yet they criticize the Critical Period Hypothesis on two grounds: (1) that it just specifies the phenomenon i.e. “the correlation between age and foreign accent rather than explains it”; and (2) “that it is not testable and so does not actually constitute a hypothesis” (171). Other factors are thought to explain such age-related effects on L2 pronunciation. Most prominent of which is variation in amount of L1 use. Flege *et al*. remark that the English pronunciation of their native Italian subjects who use much Italian shows “significantly stronger” foreign accent than those who rarely speak it, although the first group of subjects start learning English in childhood. Finally, they state that their findings do not refute the plausibility of the Critical Period Hypothesis. Yet, they believe that the passing of a Critical Period is not sufficient in itself to explain all aspects of non-nativeness in the speech of individuals who have learned English as an L2.

Influence of learning age and amount of L1 use on L2 pronunciation has previously been pointed out, though not under a technical cover term, by a number of phonologists and linguists in general. Gimson (1980: 3) argues that the child's continuous exposure to his mother tongue along with his need to use it to communicate with those around him leads to a rapid acquisition of the language. Within few years, the child achieves an adult-like mastery at all levels; and the native- language patterns become too strong and solid to permit learning foreign-language patterns. So the later the learning of another language, the more resistant and solid the L1; and therefore the less successful the L2 learning/acquisition. O'Connor (1980: 2) voices the same view. To O'Connor, as we grow older, we become at the mercy of our mother-tongue sound units and patterns which form in our minds a "certain fixed number of boxes for sounds": each box corresponds to a sound and "when we speak we go to the boxes and take out the sounds we want in the order we want them". Over years these sound boxes become so strong that, they condition everything we hear or produce. Consequently, learning a foreign language with different sound units and patterns is channeled through the L1's sound boxes. A cited example is the three sound boxes "f, θ and s" in English (e.g. "fan", "think" and "sea"). What happens is that Egyptian Arabic which does not possess a sound box for /θ/ forces the Egyptian learner to replace /θ/ by any of its similar boxes; and not to use the foreign one as it will be resisted. Ultimately, /θ/ is commonly realised by /s/, since both are similar in being fricatives and dental; and rarely by /f/, since both are fricatives.

It is indicated, thus, that the foreign learner, crippled and captivated by his mother-tongue speech habits and sound boxes, tends to reconstruct the foreign-language input along these lines by replacing the foreign sound, if there is no attested counterpart in the native language, by a similar one. So, there must be phonological similarities between the foreign and the native sound (Simo Bobda & Chumbow 1999). It might be hypothesized, in this regard, that the boxes containing the /n/ phoneme, for instance, are not necessarily identical. This is due to the different feature geometries of /n/ in each language. Thus, when an Egyptian learner, for example, goes to the /n/ box (whose features are nasal, voiced and dental) available to him and uses it to realize an English /n/, believing that they are identical, he/she is actually involved in a process of reconstructing the foreign sound to its "so called equivalent". This calls into question the notion of "equivalents" among languages. For it is not a matter of equivalent substitution, rather it is a sort of allophonic substitution where the substituted forms have, in this case, an allophonic relationship.

Achieving pronunciation accuracy, where L1 influence on L2 pronunciation is absent, is a difficult, sometimes impossible, task. Yule (1985: 151) maintains that foreign learners can achieve more native-like proficiency in writing than in speaking; and he cites as an example the Polish novelist Joseph Conrad whose spoken English reportedly retains foreign accent signs. Yule suggests that "some features (e.g. vocabulary and grammar) of a second language are easier to acquire than others (e.g. phonology)".

In their study of the perception and production of Australian English front vowels by Japanese and Korean learners, Ingram and Park (1997) contend that the two groups correlate the foreign vowels with native-language equivalents through a process of assimilation or transfer which involves normalization strategies leading to the establishment of a frame of features which is common or semi common to the foreign and native vowel. Thus the L2 learner extracts a set of features, he believes to be common, between the L1 and L2 vowels. The Japanese subjects show more sensitivity of vowel length in the production and perception of Australian English /e-æ/ contrast than their Korean counterparts. This is attributed to the fact that vowel length is a contrastive feature in Japanese rather than in Korean. Japanese subjects draw on vowel duration/length as the main cue in vowel perception and production. This is due to the lack of separate vowel quality categories for /e/-/æ/-/*a*/ in Japanese vowel-system. On the other hand, the Koreans are more sensitive to the vowel quality feature in the above contrast, as it echoes an ongoing tendency among young Koreans not to observe vowel length due to the phonological merger of two front vowels /e/ and /ɛ/, leading to a generation split among speakers above and below 45-50 years of age.

Hong Kong English (HKE) vowels furnish a further example of L1 influence. Hung (2000) reports that the number of vowels in HKE is reduced to only seven in comparison with eleven in RP, lack of the tense/lax or long/short distinction is thought to be the main reason. RP /i:-i/ contrast is reduced to HKE /i/, /e- æ/ to /ɛ/, similar to Korean English, /u:- ʊ/ to /ʊ/, and /ɔ:-ɒ/ to / ɔ/. The simple and maximally contrastive vowel system of Cantonse, in common with other languages in the same area, exerts an influence on HKE vowels. Other cross-linguistic studies on Englishes show similar patterns (Accented Arabic English: Monru, 1993; Sotho and Zulu Englishes: Wissing, 2002; Indian South African English: Mesthrie, 2002; Malaysian English: Nair Venugopal, 2000, among others).

It seems that the notion of L1 influence/transfer, to many phonologists, still lacks a set of phonetic criteria or conditions under which phonological transfer takes place (or fail to occur) (Ingram and Park 1997: 364). Yet one basic criterion unanimously agreed upon is phonological similarity between the target and the native segments. However, it is through the works of applied linguists that such criteria are set and accounted for (e.g. Oller and Richards 1973, Richards 1978, Scarella and Krashen 1980). On transfer process analysis, Askar (1998: 173) succinctly outlines Kohn's three-level transfer analysis: the first is the transfer potential which refers to the aspects of phonotic resemblance between the foreign and native sounds; the second level is the outcome of transfer which results from the first level of analysis; and the third one is "the transfer as a process" referring to the learner's prejudices and attitudes conditioning the transfer.

Germane to L1 influence and the levels of transfer analysis is the amount of exposition to L2. One major concern, in this connection, is whether the language learned is a second language or a foreign language. Technically speaking, do learners of English belong to the Outer or the Expanding Circle? It is an undeniable fact that the emerging Englishes grow in environments fostering the use of English on daily basis as a second language. A no less asserted fact is that the limited exposition to English and its artificial and inefficient acquisition, which involve a lot of conscious and analytical effort, breed a foreign language environment. Transfer, as a process primarily determined by the learners' proficiency, which is the outcome of age and amount of exposition to the target language, reflects the target language status, second or foreign.

2.1.3. Intrinsic phonological properties of the target phenomen*a*:

Some target vowels are intrinsically difficult for the foreign learner to pronounce, either because their articulation requires some lip and tongue movements that are new and unfamiliar to the learner or that their co-occurrence with other sounds-being a consonant or a vowel-makes it difficult for the learner to produce it properly. Askar (1998: 182) reports two examples of the second type difficulty: (1) the word "react" which is pronounced by Egyptian learners as /ri-ækt/, and (2) the group "the end" pronounced as /ði:-end/. In the two examples a pause breaks the vowel sequence for articulation ease.

2.1.4. Familiarity of the phonological environment in which a given vowel occurs:

It is another key factor in the process of reconstructing the foreign sounds. It is hypotheosized that the learner's decoding of the target sound is largely conditioned by the degree of this familiarity with the carrier word/structure embracing the sound pronounced.

2.1.5. Learner’s self-consciousness:

A further significant reconstruction factor is the learner’s self-consciousness towards the foreign language sounds. Yule (1985: 152) points out that one of acquisition barriers is learners’ growing self-consciousness later in their course of learning. Such self-consciousness triggers a sense of resentment and at least “embarrassment” to attempt a native-like pronunciation. They do not want to sound like foreigners. Yule elaborates:

> If this self-consciousness is combined with a lack of empathy with the foreign culture (e.g. no identification with its speakers or their customs), then the subtle effects of not wanting to sound like a Russian or an American may strongly inhibit the acquisition process (152).

That 18-year olds’ self-consciousness constructs a barrier to a native-speaker pronunciation approximation has called into question the effectiveness of teaching pronunciation at this stage of foreign language learning/acquisition, Rajadurai (2001:11) remarks that her Malysian English-speakers show limited enthusiasm about receiving training in pronunciation at the suprasegmental level, though they acknowledge the important role of such a training in raising their awareness of their pronunciation problems and subsequently improving their performance at the segmental level. Given such a high self-consciousness, foreign learners’ goal, according to Abercrombie (1991: 93), cited in Rajadurai 2001, is to have a comfortably intelligible pronunciation.

2.1.6. Learner’s attitude towards target language sounds:

Another reconstructing factor related to the preceding one is the learner’s attitude towards target language sounds. Askar (1998: 175) maintains that Egyptian students, especially rural males, do not pronounce the /p/ sound, though, it is occurring in loan words such as “pardon”, simply due to “dislikeness to be described as “effeminate”.

The above-mentioned reconstruction factors are by no means exclusive. Nevertheless, it is open for further research to identify and account for other reconstruction factors in the same study context or similar ones.

2.2. Post-reconstruction: A generative treatment:

Once the reconstruction process is completed, the non-native version of English becomes autonomous, possessing a complete linguistic system of its own. Angled generatively, the grammatical component of such a system, to which the phonological component belongs, represents forms at two levels of representation: underlying and surface. The surface representation is derived from the underlying via the application of a number of transformation rules. Goldsmith (1997: 2-3) points out that representations, levels and rules are tools employed by phonological theory to answer a number of questions: (1) what constitutes a phonological word? (2) what is the nature of alternatives? and (3) what phonetic differences are contrastive in a given language?.

Before proceeding any further, a thumbnail summary of generative phonology (GP) is given. Developed as part of the transformational generative theory, GP as formulated in SPE and tackled by subsequent generative versions adopts a phonological description based on a set of rules constituting the phonological component of grammar. This phonological component is “fed” indirectly by the syntactic component generating the surface structure which acts as an input to readjustment rules. Readjustment rules provide information about the morphological construction types needed for both segmental and non-segmental phonology. The readjusted surface structure reflects the grammatical rules of the language; and its lexical items underlying phonological representation, which take the form of feature matrices, undergo a number of phonological rules generating finally the phonetic representation. In other words, the phonetic output corresponds to the rules of grammar and the phonological contexts simultaneously. Chomsky and Halle articulate this process as follows:

> The syntactic component generates a string of informatives, some of which are given in lexical representation, with surface structure marked. The readjustment rules – convert this formal object into a string in full phonological representation, with surface structure marked. The readjustment rules thus provide a link between the syntactic and the phonological components of grammar (61).

The following figure quoted from Mohnan (1997: 27) serves as a simple representation of the previous generative process:

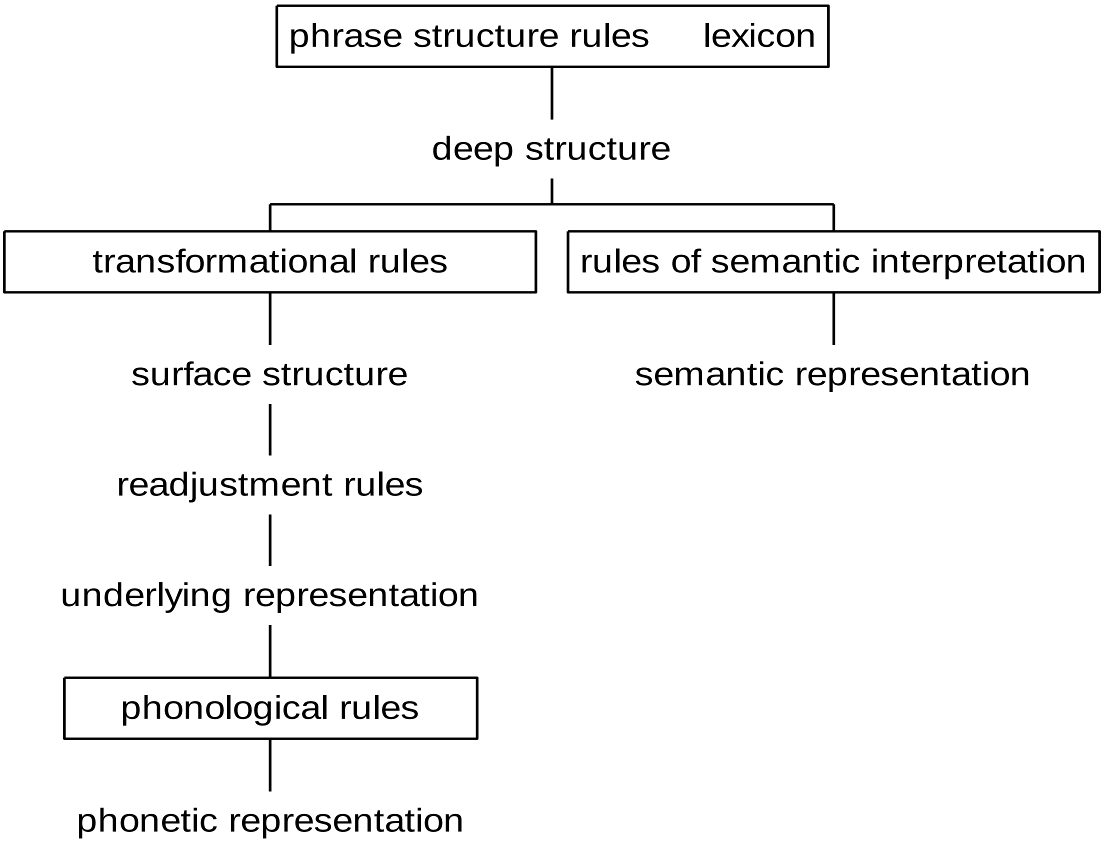

Fig. (1): Source: Mohnan (1997: 27)

We need to briefly account for three key terms in the previous discussion: underlying representation, feature matrices and phonological rules. Classical GP notion of underlying representation sounds highly abstract for many. Yet, subsequent trends call for more naturalness of underlying representation. Clark and Yallop (1996: 157) point out that the subscription to the naturalness condition as postulated by Postal (1968) entails that "any underlying representation must be such that it would surface as a pronounceable item in the language without any intervention of any rules". Similar views were later voiced and magnified by various "natural generative phonologists (e.g. Vennemann, 1972; Hooper, 1976). Their point of departure is that the rules applying to the underlying representation serve as generalisations constructed by the speaker and are typically transparent and surface-true. Thus the distinction between underlying and phonetic representations is blurred. Between these two extremes lie other generative trends whose thesis is that the underlying representation should not be too distinct from phonetic representation (Kiparsky, 1997).

Recent development in phonological theory has challenged such a rule-derivation approach and proposed the constraints approach where rules are replaced by constraints; and derivation is replaced by a process of interaction between candidate forms, governed by constraints, and the winner or the optimal candidate is the one which violates the least of constraints. This is the crux of the Optimal Theory argument launched by Prince & Smolensky (1993). Rules /constraints are formulated in light of feature matrices. SPE (1968) postulates that phonetic representation consists of a-sequence of phonetic segments, each of which is nothing other than a set of "phonetic feature specifications" (164). Such features constitute a basis on which rules necessary for a proper and adequate phonological description are set. Segments are described or specified in terms of symbols acting as convenient short-hands of a number of features. Features can be binary (having two values – and +), non-binary (having more than two values), or monovalent having one value (+ or -). For instance, the vowel /i:/ can be specified in terms of the features of which it is composed as follows:

+ syllabic
- consonantal
+ voiced
+ high

Rules, using features and a limited number of notational devices, follow one or two strict orderings: cyclic and non-cyclic. Cyclic ordering involves the application of a rule sequence, R_1, … R_n to the innermost constituents of a morphologically-complex structure with each applied once until the application of R_n which erases the innermost brackets of the surface structure. Rules "interact in such a way that the output of the first rule serves as an input to the next rule" (60). Forming a block, rules are ordered either disjunctively (if one of these rules applies to a certain substring, the other members of the block are not applicable to this substring in this stage of cycle) or conjunctively (when rules are not subject to this restriction on their application). A frequently-cited example is the rule cyclicity in the derivation of the noun "eraser":

[N# [V# erase #] vr#] N

Rules apply in the first cycle to the innermost bracketed underlying verb "erase" erasing these brackets, then in the next cycle to the noun "eraser" which is the maximal string that contains no brackets(5). The number of rule application is determined by the morphological complexity of the structure derived(6). In the structure "the blackboard eraser":

[NP [A black] ∧ [N[N board] N [N eraser] N] N] NP in the first cycle, stress is assigned to the minimal constituents (the inner-most bracketed, “black”, “board” and “eraser”). In the second cycle, the compound rule is applicable assigning primary stress to the nouns “board” and “eraser”. Finally, the third cycle is applied giving primary stress to “board”, weakening the rest of stresses and yielding the final derivation.

Non-cyclical rules, on the other hand, apply only at word boundaries. These make up the “noncyclical phonology”. In SPE, the term “word” is “an element of the form ## … ##, where … contains nonoccurrence of the boundary markers ##. The application of such rules does not follow a sequential order. Prominent among these rules are those related to lexical redundancy rules, vowel alternations, vowel shift rule and consonant system of English([7]).

Adopting GP theory, especially the conventional rule and derivation trend, is driven by a number of considerations. The first is that GP provides an account of not only the surface forms, like the taxonomic approaches, but also the underlying representations from which the surface forms are derived. This proves quite useful in the treatment of the vowel reduction patterns in NEs and NNEs alike. Highly analytic and penetrating as such, GP enjoys a high degree of formalism. Such formalism is manifested in its formal apparatus which specifies sounds, features and rules, the setting of limits on what is possible, and the possibility of being revised and amended if it proves to be wrong or inadequate for some of the world’s languages (Clark and Yallop, 1996: 140). The second consideration is the theory’s explanatory power exhibited in the fact that the rule-based model is restricted in principled ways securing an appropriate explanation for natural-language phenomena. The third consideration stems from its descriptive adequacy, a major GP property. Descriptive adequacy is materialized by setting a finite number of rules which are capable of accounting for an endless number of permissible forms. The vowels of a particular language are commonly placed on a quadrilateral to locate their exact phonetic qualities relative to the Cardinal Vowels(8).

Cardinal Vowel system fits into the frame of the current study, as it is still working successfully in accounting for the sounds of a large number of languages, thanks to the phoneticians' ongoing effort to provide accurate judgment of F1 on the one hand and the distance between F1 and F2 on the other. A second reason lies in the fact that, being universal points of reference, it would be of a perfect benefit in such a study where EE vowel quality is accounted for. Having adopted the Cardinal Vowel system as a frame of reference, vowel features in EE are to be discussed. Vowels of any language are customarily treated in light of six features, not all of them apply to all languages: **(1) tongue height, (2) tongue advancement, (3) rounding, (4) duration, (5) rhoticization and (6) nasalization.**

English vowels are usually classified as front, central and back. This is ascribed to the different highest points of the tongue involved in the production of a given vowel. Tongue is pushed forward, producing the front vowels, remains neutral forming the central vowels, or is retracted to the back of the mouth to produce the back vowels. Acoustically, tongue advancement is associated with F2. Back vowels have low F2 values whereas front vowels have high F2 values with the central vowels standing in between. Vowels are further divisible into high, mid-and low, based on how close or farther is the tongue from the roof of the mouth (**tongue height**). F1 values are commonly used in accounting for this feature. F1 is low when the vowel is high and vice versa. **Rounding** in English, is associated with back vowels, unlike other languages such as Danish and Old English which have front rounded vowels and back unrounded vowels. Round vowels usually display low F2 and F3. In some African languages, the size of the pharynx is crucial in dividing vowels into **wide/tense** and **lax/narrow**. In wide/tense vowels, the root of the tongue is bunched forward and the larynx is lowered so that the part of the vocal tract in the pharynx is enlarged. In narrow vowels, there is no advancement of the tongue root or lowering of the larynx. In English the feature "width" is significant only in conjunction with vowel height: the high vowels (i: and u:) are wider than the mid-high vowels (i and ʊ). Moreover, the terms “wide” and “narrow” are often replaced by the much more controversial terms “**tense**” and “**lax**” respectively. Tenseness is generally described as a tightening in the vocal tract muscles signaling strong articulation. Tense vowels are thought to be longer and more peripheral in quality than corresponding lax vowels. The tendency to replace **wide/narrow** terms by the **tense/lax** ones is not largely favored by many phoneticians and phonologists. Ladefoged (1982) contends that this may apply to high English vowels which really display tongue advancement and tension, and hence, the term tense is in place. Examples often quoted from English are “sea” and “do” in open syllables and “seat” and “food” in closed syllables. On the other hand, lax vowels are not necessarily narrow, in addition to pharynx width and tongue tension. Clark and Yallop (33) maintain that the tense/wide vs. lax/narrow distinction rests on vowel **length/duration** (in msec). It should be noted, however, that vowel **length/duration** is of two kinds (1) intrinsic where the vowel is inherently long; and (2) extrinsic where the vowel is influenced by the adjacent consonants and stress patterns. **Rhotacization** is one vowel rule not operative in RP, however, it is in place in this study as EE speakers do not observe the loss of post-vocalic (r) pronunciation. Acoustically **rhotacization** is detected when there is a marked lowering of F3. **Nasalization** of vowels involves a lowering of soft palate so that air can pass through both the oral and nasal cavities. F2 is commonly marked by the diacritic [^{n}] over the vowel. Acoustically, Nasals have lower formants than those of vowels.

Vowel quality features are summarized in Table (1).

Table (1): Vowel features and acoustic measurements[9]:

Feature	Acoustic measurements
1. Tongue advancement Front Back Central	Associated with F2 values in Hz High F2 Low F2 Intermediate F2
2. Tongue height High Low Mid	Associated with F1 values in Hz Low F1 High F1 Intermediate F1
3. Rounding Round Non-round	Associated with F2 values in Hz Low F2 High F2
4. Length/duration	Measured in m. sec.
5. Rhotasization	Associated with F3 values in Hz
6. Nasalization	Associated with formant transition to the following nasal

3. DATA ANALYSIS AND RESULTS

3.1. RP and EE vowels inventories: Acoustic measurements:

/i:/

Acoustic data in Table (2), which are also represented in the vowel chart of Fig. (2) and figures of RP formant frequencies from other sources given in Table (3), show that F1 frequencies of EE /i:/ are significantly higher than that of RP /i:/. This means that the former is significantly lower than the latter. F2 values indicate that EE /i:/ is slightly fronter than its RP counterpart. In fact, it is identical to Cardinal front vowels in their fully front property, however, it is nearer to Cardinal Vowel (2) than to (1) in the degree of height. Since the RP version is not as front as such, it is hypothesized that the EE speaker reconstructs the input RP version to the nearest and most similar version available in his native Arabic and comes up with the surface from which is notationally cited, using the diacritic (<), as /$^{<}$i:/[10]. Egyptian Arabic has a simple vowel chart consisting of six vowels along with their long versions (Ezzat, 1973)[11]. They contrast mainly in length. Previous studies, mostly based on auditory criteria, indicate that Arabic, like so many languages, is one language which observes the Principle of Sufficient Perceptual Separation; whereby the sounds of a language are kept acoustically distinct so as to make it easier for the listener to distinguish one from another (Ladefoged: 1982). To this effect, Arabic vowels are relatively evenly spaced around the outside lines of vowel area.

Table (2) The /i:/ vowel average formant frequencies in EE and RP (standard deviations are given in brackets)

Example	F1				F2			
	EE	RP	T	Sig. level	EE	RP	t	Sig. level
Beat	405 (52)	284 (36)	3.792	Sig. at 0.01	2632 (411)	2512 (307)	0.471	Non. sig.
Bead	434 (95)	289 (38)	2.381	Sig. at 0.05	2586 (239)	2483 (293)	0.645	Non-sig.

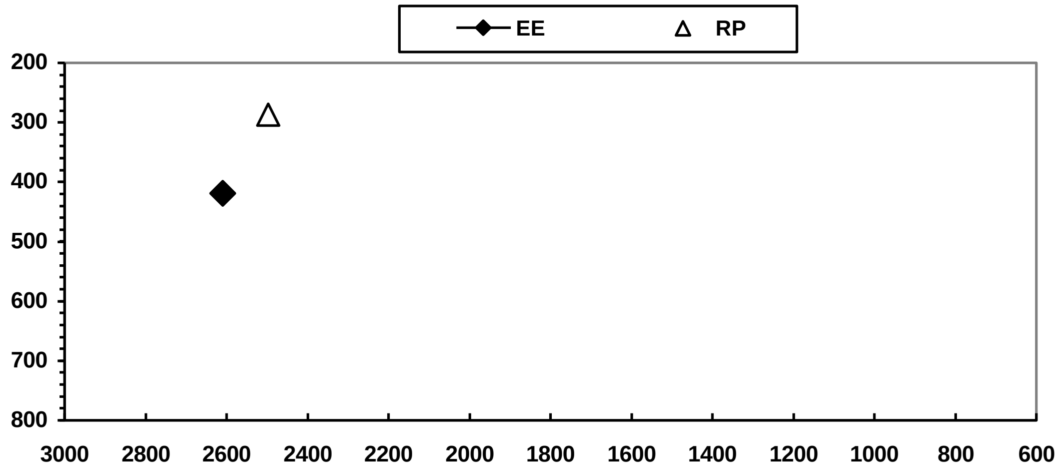

Fig. (2): F1 and F2 plots of the /i:/ vowel in EE and RP

Table (3): The /i:/ vowel values in RP. Source; Easton & Bauer (2000).

	F_1	F_2	F_3
RP 1 male (Wells 1963)	285	2373	3088
RP 2 female (Deterding 1990)	319	2723	-
RP 2 male (Deterding 1990)	275	2221	-
RP 3 female (Deterding 1997)	303	2654	3203
RP 3 male (Deterding 1997)	280	2249	2765

As far as length or duration is concerned, EE /i:/ is relatively shorter than the RP one. Table (24) shows that there are no significant differences in duration between EE /i:/ and RP/i:/, when followed by a voiced consonant. On the other hand, significant differences between the two versions at 0.01 level when followed by a voiced consonant are clear, RP /i:/ is longer. It is commonly held that length is a key contrastive feature in Arabic. Vowels are mainly contrasted on length basis, this is why EE /i:/ is collectively equal in length to RP /i:/, yet the phonological rule of lengthening vowels before voiced consonants is not operative in Arabic. Consequently, /i:/ length, in both cases, remains unchanged in EE. Thus, it might be proposed that RP /i:/, which is specified as front, high and long/tense, is reconstructed to the fronter, lower and shorter, when followed by a voiced consonant, EE [<i.].

/i/

Study figures in Table (4) RP figures taken from other sources in Table (5) and Fig. (3) illustrate that there are significant differences at 0.01 level in F1 frequencies between the two versions. EE /i/ is significantly lower and slightly fronter than RP /i/. It is evident that RP /i/ ranges from mid-close to close and from front to central, whereas EE /i/ displays extreme properties detaching it away from the center. In this regard, EE /i/ bears considerable resemblance to the Australian and New Zealand /i/, all are lower, and fronter than RP/i/ (Easton & Bauer, 2000).

Table (4) The /i/ vowel average formant frequencies in EE and RP (standard deviations are given in brackets)

Example	F1				F2			
	EE	RP	t	Sig. level	EE	RP	t	Sig. level
Bit	597 (86)	393 (44)	3.90	0.01	2161 (135)	2062 (173)	1.090	Non-sig.
Bid	587 (69)	375 (47)	4.98	0.01	2200 (69)	1943 (260)	1.789	Non-sig.

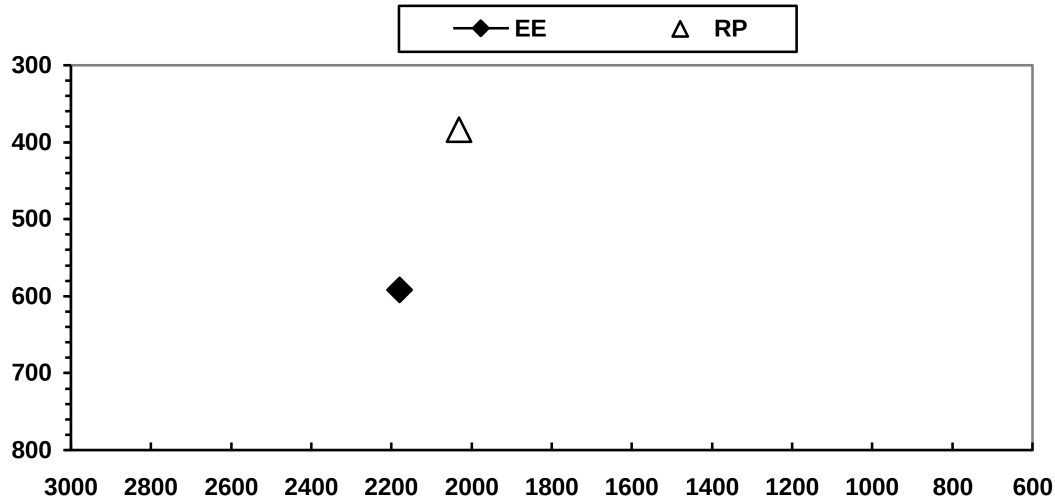

Fig. (3): F1 and F2 plots of the /i/ vowel in EE and RP

Table (5): The /i/ vowel values in RP. Source: Easton & Bauer (2000)

	F_1	F_2	F_3
RP 1 male (Wells 1963)	356	2098	2696
RP 2 female (Deterding 1990)	432	2296	-
RP 2 male (Deterding 1990)	382	1958	-
RP 3 female (Deterding 1997)	384	2174	2962
RP 3 male (Deterding 1997)	367	1757	2556

Concerning duration, data in Table (24) display that RP /i/ is significantly longer than that of EE. Duration figures of /i:/ and /i/ in EE indicate that EE speakers possess an extra awareness of length; to them /i/ is the short counterpart of /i:/ and they exaggerate in showing such a "short" property. Influence of the following consonant, voiced and voiceless, patterns the same as /i:/ in the two varieties. Though close in length value before a voiceless, RP version is significantly longer when followed by a voiced consonant. Thus, it is proposed that RP /i/ is reconstructed to $\left[\begin{matrix} < \mathrm{i} \\ \quad \vee \end{matrix}\right]$ which reads that EE /i/ is a fronter, lower and significantly shorter version.

/e/

F1 and F2 frequencies of /e/ given in Table (6), figures of RP formants frequencies from other sources given in Table (7) and Fig. (4) uncover that the features of both versions of /e/ are very similar in the two varieties. However, EE /e/ is so slightly lower and fronter than its RP equivalent. Duration figures of the two groups display that RP /e/ is significantly longer in duration in all cases. This suggests that EE speakers specify /e/, along with /i/, as short vowels and “exaggerate” in shortening them so as to make them quite distinct from their “long” counterparts /i:/ and [ee] in Egyptian Arabic. Similar to L1 short /e/, reconstruction of RP does not represent a considerable difficulty for the EE speaker. It is also noted that EE /i/ and /e/ are very close on the vowel chart suggesting frequent cases of overlap, where words such as /sed/ and /bed/ can be pronounced and heard as /sid/ and /bid/. In short EE /e/ might be specified as front, mid-open and over-short.

Table (6) The /e/ vowel average formant frequencies in EE and RP (standard deviations are given in brackets)

	F1				F2			
Example	EE	RP	t	Sig. level	EE	RP	t	Sig. level
Bet	664 (111)	617 (51)	0.70	Non-sig.	2100 (258)	2013 (166)	0.55	Non-sig.
Bed	624 (85)	598 (55)	0.49	Non-sig.	2081 (237)	2014 (184)	0.45	Non-sig.

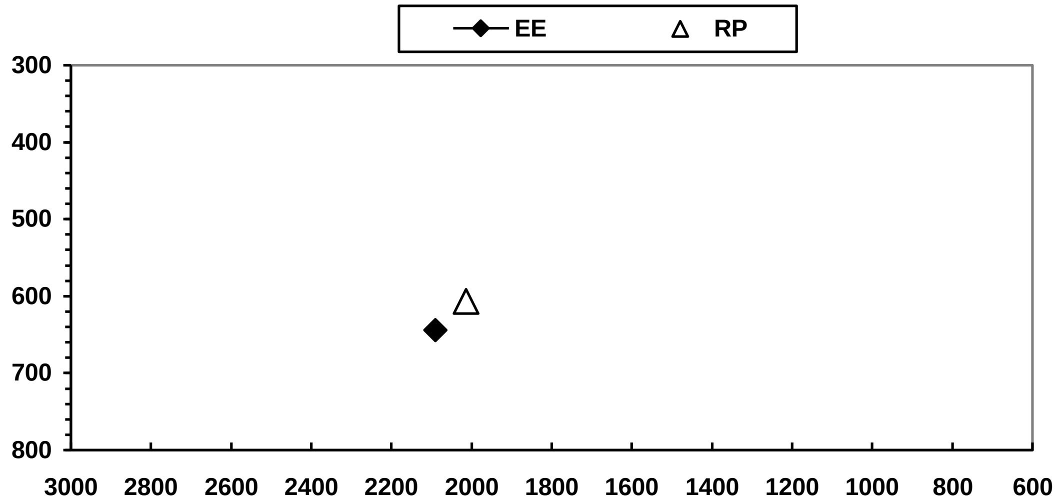

Fig. (4): F1 and F2 plots of the /e/ vowel in EE and RP

Table (7): The /e/ vowel values in RP. Source: Easton & Bauer (2000).

	F_1	F_2	F_3
RP 1 male (Wells 1963)	569	1965	2636
RP 2 female (Deterding 1990)	645	2287	-
RP 2 male (Deterding 1990)	560	1797	-
RP 3 female (Deterding 1997)	719	2063	2997
RP 3 male (Deterding 1997)	494	1650	2547

/æ/

The present data given in Table (8), the additional RP figures given in Table (9) and figure (5) show that there are significant differences at 0.01 level between F1 and F2 frequencies of /æ/ in the two varieties. F1 frequencies indicate that RP /æ/ is significantly lower than EE /æ/. F2 frequencies display that EE /æ/ is fronter than RP /æ/ and hence, it is more similar to Cardinal Vowel (4). This goes consistently with EE tendency to make the RP front vowels fronter. Influence of the following consonant on the vowel length patterns the same as /i:/. Significant differences at 0.01 level between EE/æ/ and RP /æ/ when followed by a voiced consonant is clear in Table (24). In short, EE /æ/ is less open significantly, fronter and relatively shorter than RP /æ/. A phonetic transcription would be /<æ/.

Table (8): The /æ/ vowel average formant frequencies in EE and RP (standard deviations are given in brackets).

Example	F1				F2			
	EE	RP	t	Sig. level	EE	RP	t	Sig. level
Bat	685 (46)	865 (210)	3.14	Sig. at 0.01	2229 (195)	1794 (94)	3.69	Sig. at 0.01
Bad	647 (57)	873 (38)	2.91	Sig. at 0.01	2388 (376)	1774 (45)	2.75	Sig. at 0.01

Table (9): The /æ/ vowel values in RP. Source: Easton & Bauer (2000)

	F_1	F_2	F_3
RP 1 male (Wells 1963)	748	1746	2466
RP 2 female (Deterding 1990)	1011	1759	-
RP 2 male (Deterding 1990)	732	1527	-
RP 3 female (Deterding 1997)	1018	1799	2869
RP 3 male (Deterding 1997)	690	1550	2463

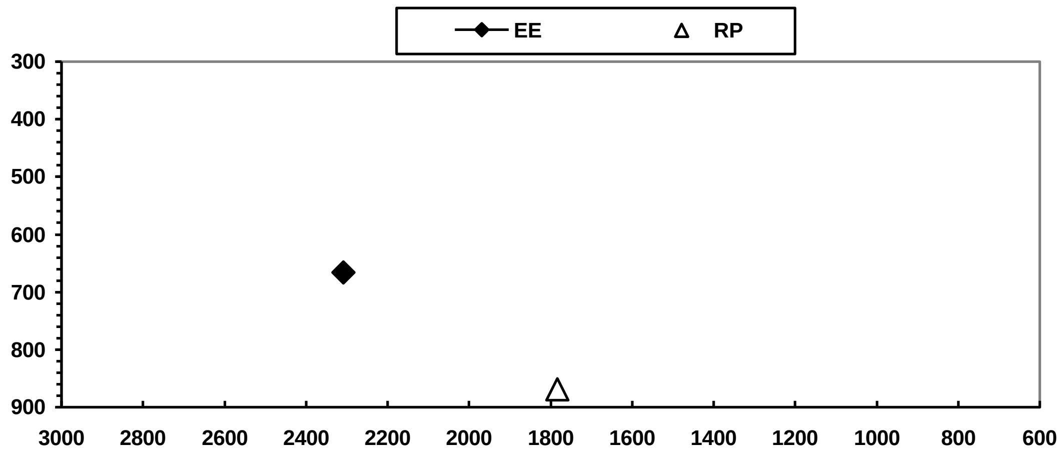

Fig. (5): F1 and F2 plots of the /æ/ vowel in EE and RP

F1 and F2 frequencies of /ʌ/ vowel in the present data and other additional RP figures given in Tables (10 and 11) respectively, and further illustrated in Figure (6) uncover that the two versions are semi-identical. Both are central and open.

/ʌ/

Table (10): The /ʌ/ vowel average formant frequencies in EE and RP (standard deviations are given in brackets).

Example	F1				F2			
	EE	RP	t	Sig. level	EE	RP	t	Sig. level
Cut	804 (34)	820 (14)	0.75	Non-sig.	1443 (154)	1475 (199)	0.312	Non-sig.
Bud	772 (48)	810 (17)	1.31	Non-sig.	1362 (129)	1359 (23)	0.036	Non-sig.

Table (11): The /^:/ vowel values in RP. Source & Bauer (2000).

	F_1	F_2	F_3
RP 1 male (Wells 1963)	722	1236	2537
RP 2 female (Deterding 1990)	813	1422	-
RP 2 male (Deterding 1990)	695	1224	-
RP 3 female (Deterding 1997)	914	1459	2831
RP 3 male (Deterding 1997)	644	1259	2551

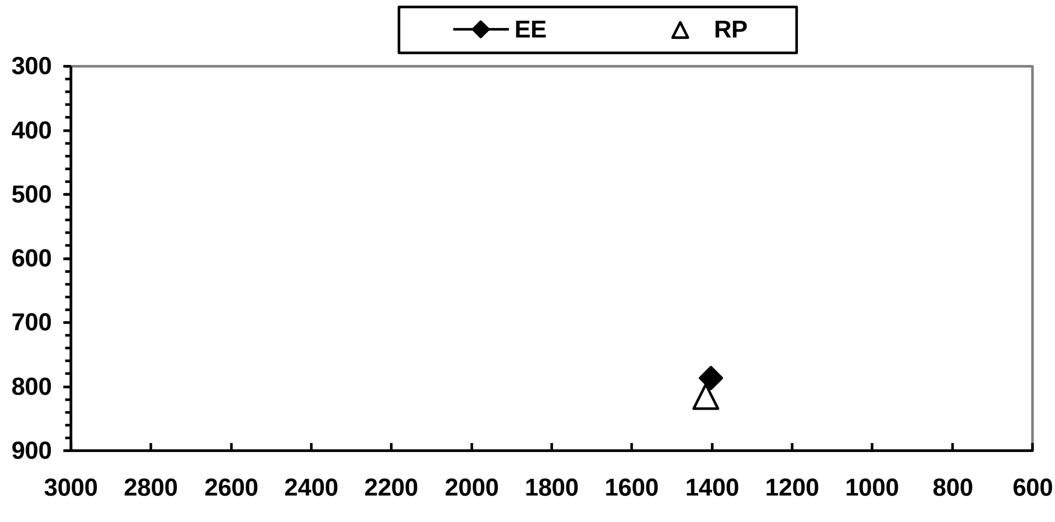

Fig. (6): F1 and F2 plots of the /^/ vowel in EE and RP

Duration figures in Table (24) show that there are significant differences in length at 0.01 level between the two versions of /^/

preceding the voiceless /t/ in favor of RP and at 0.05 level preceding the voiced /d/ in favor of RP too. This asserts the fact that RP speakers exaggerate the shortening of the RP lax/short vowels. EE /ʌ/, thus, is specified as central, open and extremely short.

/a:/

Data given in Table (12 and 13) respectively and Figure (7) show that EE */a:/* in the first example "heart" is pronounced with a vowel whose F1 and F2 frequencies are close in value to those of EE /e/, though it is somehow nearer to the center and longer in duration. This "faulty" or deviated pronunciation can be attributed to the orthographs: [ea] which are variously pronounced (e.g. /e/ as in "head", /i:/ as in "meat", /3:/ as "earth", and /ei/ as in "great") as /e/- to /e:/ to /3:/. Thus, EE speakers draw in their pronunciation on orthography when they do not have an established "correct" phonological version or representation of the sound derived from listening to a native speaker. Linked to orthography are the analogies EE speakers make to match an orthographic from (of a word they do not know the pronunciation of which) to a similar one of a word they know its pronunciation.

Table (12): The vowel */a:/* average formant frequencies in EE and RP (standard deviations are given in brackets)

Example	EE	RP	t	Sig. level	EE	RP	t	Sig. level
Heart	629 (109)	745 (5)	1.80	Non-sig.	1874 (496)	1095 (90)	2.64	Sig. at 0.05
Hard	754 (61)	755 (85)	0.02	Non-sig.	1270 (129)	1174 (85)	1.207	Non-sig.

Table (13): The */a:/* vowel values in RP. Source: Easton & Bauer (2000).

	F_1	F_2	F_3
RP 1 male (Wells 1963)	677	1083	2540
RP 2 female (Deterding 1990)	779	1181	-
RP 2 male (Deterding 1990)	687	1077	-
RP 3 female (Deterding 1997)	910	1316	2841
RP 3 male (Deterding 1997)	649	1155	2490

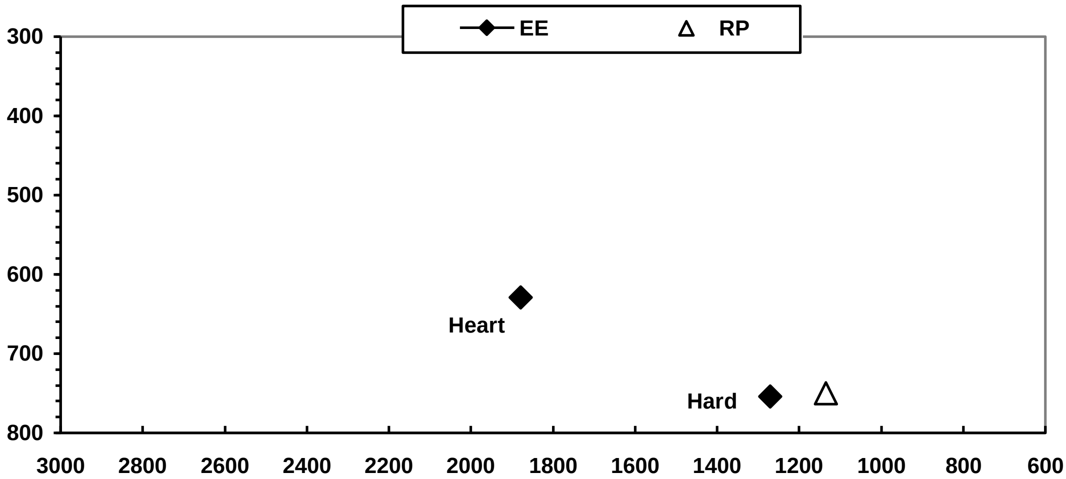

Fig. (7): F1 and F2 plots of the */a:/* vowel in EE and RP

The exact qualities of */a:/* in EE are manifested in the figures of the word "hard". The orthograph [a] cannot be pronounced as /æ/ due to the following /r/ which is velarized in this example and in turn velarizing [a] to be pronounced as /*a*:/. "hard" figures uncover that the two versions of */a:/* are relatively similar: both are open and back, though EE*/a:/* is opener and fronter. It is commonly believed that */a:/* is a universal vowel which requires the least articulatory efforts. Its two formants (F1 and F2) are close or adjacent to each other. This makes the forward part of the mouth/oral cavity function as a resonator adding considerable amplitude to the vowel. As for duration, RP version is slightly, though not significantly, longer. Further, lips are not rounded or spread in the two varieties.

/ɒ/

Figures in Tables (14) and (15) and Fig. (8) show that the two versions of /ɒ/ have similar F1 frequencies indicating that the vowel is between open and mid-open in tongue height. F2 values, however, indicate that EE /ɒ/ is not as back as the RP one. This, in turn, suggests that the degree of lip rounding will be less in EE /ɒ/, as there is a one to one correspondence between lip rounding degree and that of backness. Moreover, RP /ɒ/ is midway between Cardinal Vowels 5 and 6, though it is not "quite" fully back. EE /ɒ/, on the other hand, separates a bit away from this location; being fronter and less back. Concerning length, EE /ɒ/ is shorter, indicating that the RP version is usually stressed.

Table (14): The /ɒ/ vowel average formant frequencies in EE and RP (standard deviations are given in brackets).

Example	F1				F2			
	EE	RP	t	Sig. level	EE	RP	t	Sig. level
Pot	626 (97)	605 (70)	0.347	Non-sig.	1145 (145)	929 (35)	2.490	Sig. at 0.05
Cod	660 (73)	599 (42)	1.365	Non-sig.	1258 (135)	950 (30)	3.821	Sig. at 0.05

Table (15): The /ɒ/ vowel values in RP. Source: Easton & Bauer 2000)

	F_1	F_2	F_3
RP 1 male (Wells 1963)	599	891	2605
RP 2 female (Deterding 1990)	602	994	-
RP 2 male (Deterding 1990)	593	866	-
RP 3 female (Deterding 1997)	751	1215	2790
RP 3 male (Deterding 1997)	558	1047	2481

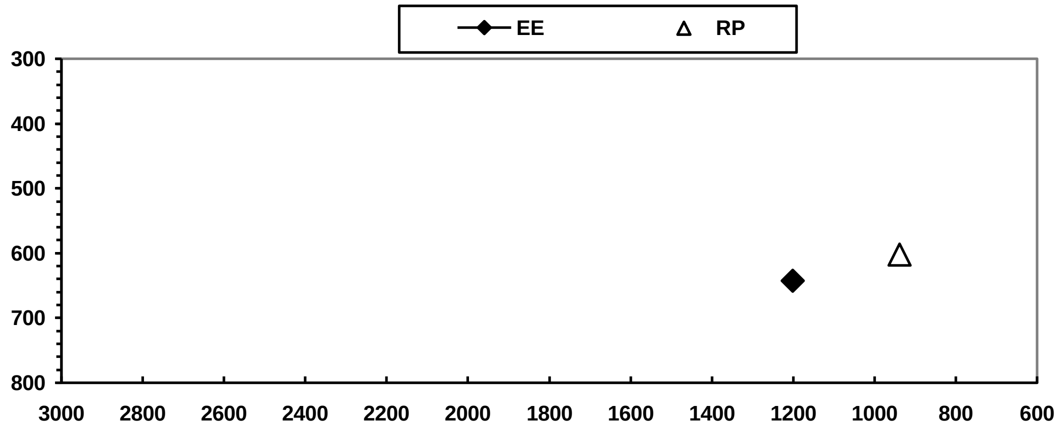

Fig. (8): F1 and F2 plots of the /ɒ/ vowel in EE and RP

Duration values given in Table (24) reassert the two previously-mentioned findings (1) that length in EE vowels is not influenced by the following consonant and (2) that EE speakers exaggerate in shortening RP lax vowels to achieve greater contrast in length between "long" and "short" vowels.

/ɔ:/

F1 and F2 figures of RP /ɔ:/, as shown in Tables 16 and 17 and Fig. (9), reveal that it is considerably back and round as this is represented in the low F2 frequencies. Moreover, its F1 frequencies place midway in tongue height between Cardinal Vowels 6 and 7(12). In contrast, EE /ɔ:/ is significantly lower and considerably less back. Duration figures given in Table (24) suggests that EE /ɔ:/ observation of the following consonant effect is much more limited. So, EE /ɔ:/ can be specified as relatively less rounded than that of RP, as shown in its F2 frequencies.

Table (16): The /ɔː/ vowel average formant frequencies in EE and RP (standard deviations are given in brackets)

	F1				F2			
Example	EE	RP	t	Sig. level	EE	RP	t	Sig. level
Caught	630 (156)	462 (16)	2.02	Non-sig.	1494 (772)	932 (275)	1.214	Non-sig.
Cord	622 (57)	464 (5)	4.64	Sig. at 0.01.	1345 (627)	955 (274)	1.032	Non-sig.

Table (17): The /ɔː/ vowel values in RP . Source: Easton & Bauer (2000).

	F_1	F_2	F_3
RP 1 male (Wells 1963)	449	737	2635
RP 2 female (Deterding 1990)	431	799	-
RP 2 male (Deterding 1990)	453	642	-
RP 3 female (Deterding 1997)	389	888	2796
RP 3 male (Deterding 1997)	415	828	2619

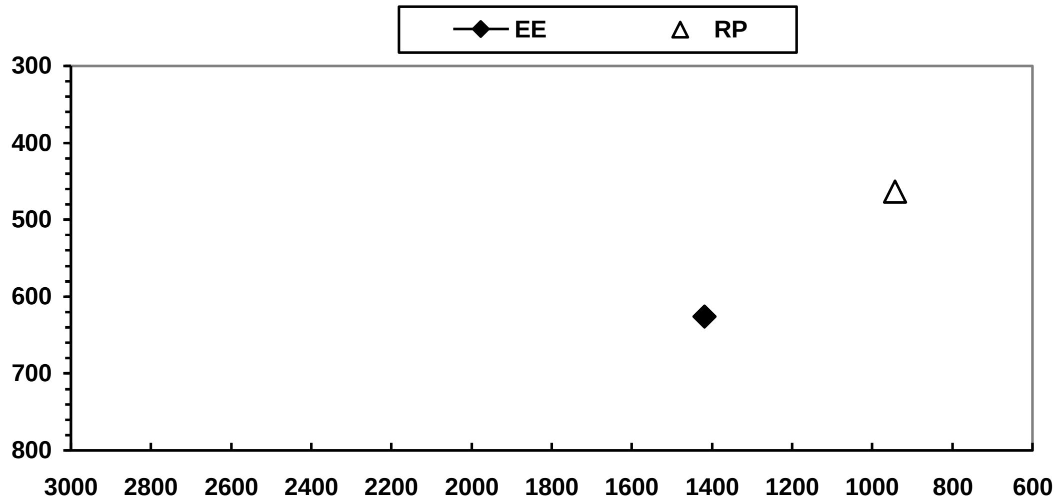

Fig. (9): F1 and F2 plots of the /ɔː/ vowel in EE and RP.

/ʊ/

As shown in Tables (18) and (19) and Fig. (10), RP /ʊ/ displays significantly lower F1 frequencies indicative of a significantly +high feature. Yet, F2 frequencies are semi identical. Similar to American English, both versions are less back and nearer to the center. This denotes a less degree of lip rounding and backness. This is why some EE speakers are guided by orthography in reconstructing the target vowel to /ʌ/. As the orthograph (u) is commonly pronounced as /ʌ/ in words such as "cut" and "but" – the latter being identical to the given word due to lack of P/b distinction – some EE speakers apply this "rule" to "put". Singh and Singh (1982: 218) confirm this:

> lip rounding is an added feature of /ʊ/. In perceptual confusions, /ʊ/ is most frequently confused with the low-central, neutral vowel /ʌ/. It is seldom confused with the vowel /u:/, although /ʊ/ and /u:/ are adjacent to each other on the vowel diagram.

Table (18): The /ʊ/ vowel average formant frequencies in EE and RP (standard deviations are given in brackets).

Example	F1				F2			
	EE	RP	t	Sig. level	EE	RP	t	Sig. level
Put	682 (105)	384 (86)	4.555	Sig. at 0.01	1178 (131)	1056 (132)	1.445	Non-sig.
Wood	576 (110)	413 (100)	2.354	Sig. at 0.05	1098 (161)	1130 (156)	0.310	Non-sig.

Table (19): The /ʊ/ vowel values in RP. Source: Easton & Bauer (2000)

	F_1	F_2	F_3
RP 1 male (Wells 1963)	376	950	2440
RP 2 female (Deterding 1990)	414	1203	-
RP 2 male (Deterding 1990)	414	1051	-
RP 3 female (Deterding 1997)	410	1340	2697
RP 3 male (Deterding 1997)	379	1173	2445

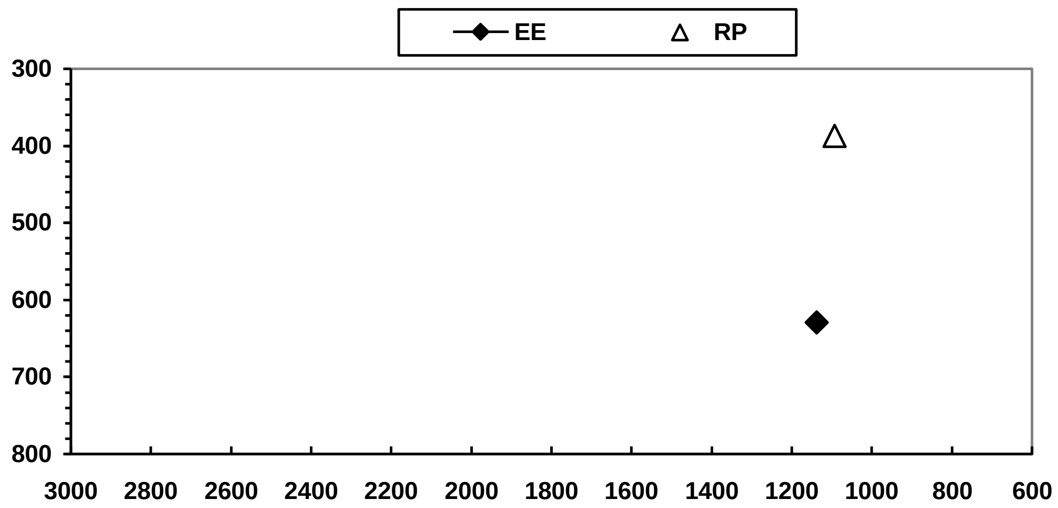

Fig. (10): F1 and F2 plots of the /ʊ/ vowel in EE and RP

The EE version of /ʊ/ in "wood" diverges from that in "put". Its F1 and F2 frequencies indicate that it is similar to EE /ʊ:/. This also may be attributed to the orthographs "oo" which are sometimes pronounced as /u:/ as in "food". The orthographs [oo] are roughly associated with length and this explains the longer duration of the "wood" version (Table 24). Moreover, /ʊ/ versions in EE and RP in "put" have identical duration, a reasserted fact denoting that EE speakers specify /ʊ/, /e/, /ʌ/ and /i/ as extremely short/lax vowels. In short, EE /ʊ/ is specified as a mid-open, central to back, short vowel.

/u:/

Tables (20 and 21) and Fig. (11) demonstrate that RP /u:/ is high, indicated by the low F1 frequencies; back and rounded indicated by the moderate F2 frequencies. It should be noted, at least in this study, that RP /u:/ is less back than it is reported in previous literature (Roach, 1983, Gimson, 1980, among others). Its longer duration in the RP data confirms the fact that this vowel is tense and consequently stressed, occurring in both open and closed syllables. Further, it is evident that this duration period is almost doubled when /u:/ is followed by a voiced consonant.

Table (20): The /u:/ vowel average formant frequencies in EE and RP (standard deviations are given in brackets).

Example	F1				F2			
	EE	RP	t	Sig. level	EE	RP	t	Sig. level
Root	522 (62)	305 (49)	5.59	Sig. at 0.01	1078 (214)	1123 (178)	0.333	Non-sig.
Rude	534 (114)	315 (31)	3.21	Sig. at 0.01	1311 (393)	1106 (166)	0.867	Non-sig.

Table (21): The /u:/ vowel values in RP. Source: Easton & Bauer (2000).

	F_1	F_2	F_3
RP 1 male (Wells 1963)	309	939	2320
RP 2 female (Deterding 1990)	339	1396	-
RP 2 male (Deterding 1990)	302	1131	-
RP 3 female (Deterding 1997)	328	1437	2674
RP 3 male (Deterding 1997)	316	1191	2408

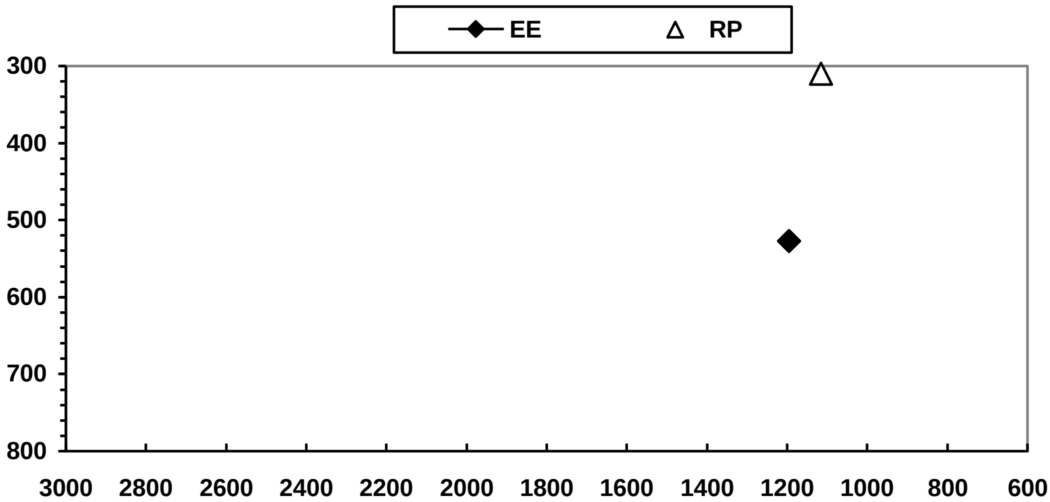

Fig. (11): F1 and F2 plots of the /u:/ vowel in EE and RP

In contrast, data show that EE /u:/ is lower as confirmed by F1 values; and slightly nearer to the center and less round as displayed by F2 values. While, RP /u:/ is commonly described as not very different from Cardinal Vowel 8, (Roach 1983), EE /u:/ is a bit away from it. Examination of the back EE vowels reveals that all of them are less back.

This may be attributed to the fact that EE /ʊ/ and /u:/ are processed as similar versions of the EA /ʊ/, a half-close back to central rounded vowel, and /oo/ close-rounded back to central, respectively. So, the quasi-centrality of such vowels explains the EE versions to be nearer to the center than their RP counterparts. And since /u:/ and /ɔ:/, on the one hand, and /ʊ/, /ɒ/ and /ʌ/, on the other may overlap, the EE speaker may adopt a tendency towards "centralized" vowels such as /o/ and /oo/, mid- to half-close back rounded vowels, short and long.

Data also show that EE /u:/ is remarkably longer in duration than other EE "long counterparts". This indicates that the mother tongue /ʊʊ/, whose prime feature is "+long", is reconstructed to the EE long /u:/. It is also worth noting that the influence of the following consonant on vowel length in these examples is totally absent, two findings repeatedly asserted in the present study.

/3:/

In Tables (22 and 23) and Fig. (12) F1 and F2 frequencies specify the RP /3:/ as a fairly central-half-close half open neutral vowel. On the contrary, EE /3:/ data display two representations or realizations. The F1 and F2 values of the first one locate it between RP /3:/ and /^/, even nearer to /^/. The second representation shows identical characteristics to those of the vowel in the word "heart" discussed above. F1 and F2 frequencies of the vowel in "head" locate it midway between EE /i/ and /e/. In other words, it is front mid-close mid-open and spread.

Table (22): The /3:/ vowel average formant frequencies in EE and RP (standard deviations are given in brackets).

Example	F1				F2			
	EE	RP	t	Sig. level	EE	RP	t	Sig. level
Hurt	662 (73)	527 (95)	2.74	Sig. at 0.05	1614 (442)	1496 (48)	0.451	Non. sig.
Heard	596 (96)	15 (100)	1.30	Non sig.	2180 (563)	1491 (9)	2.065	Sig. at 0.05

Table (23): The /3:/ vowel values in RP. Source: Easton & Bauer (2000).

	F_1	F_2	F_3
RP 1 male (Wells 1963)	501	1381	2436
RP 2 female (Deterding 1990)	650	1593	-
RP 2 male (Deterding 1990)	513	1377	-
RP 3 female (Deterding 1997)	606	1695	2839
RP 3 male (Deterding 1997)	478	1436	2488

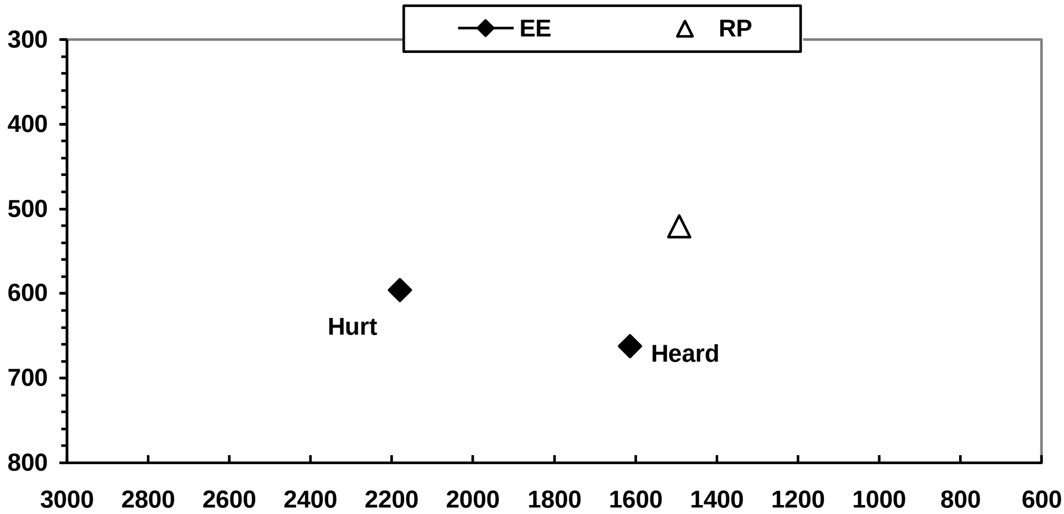

Fig. (12): F1 and F2 plots of the /3:/ vowel in EE and RP

One possible explanation is that /3:/ is realized as a semi /^/ when it is realized by the orthograph [u] as in “burn”. If realized by [i] it can be pronounced as /i/ as in “girl”, as /e/ as in “certain” and as [ɒ] as in “work”. It should also be noted that the pronunciation of /r/ in EE does not give room to vowel prolongation, yielding shorter versions of all the preceding vowels. This also applies to the semi /^/ version which is “-

long" due to /r/ presence. Another difficulty associated with the proper pronunciation of /3:/ in EE is that a native-like pronunciation triggers a sense of unfamiliarity with the vowel as it has no similar equivalent in Egyptian Arabic. A third problem is represented in most EE speakers' over-consciousness that breeds a sense of resentment to sound like foreigners. It should be noted that /3:/ is not always pronounced either way all the time and by all speakers of EE. It just happens that the study subjects who are basically mesolectals show such representations.

Figures 13 and 14 show that most, if not all, EE vowels tend to be fronter than RP ones. This is manifested in their high F2 frequencies. However, caution must be exercised here. The back EE vowels are not realized as back, not because their native counterparts are not back, but because it happens that the orthography of the examples recorded is misleading yielding “different representations”. So, the **Sufficient Perceptual Separation Principle**, discussed above, which works perfectly in Arabic vowels in their tendency to achieve the maximal vowel distinction by placing most, if not all of them very near to the Primary Cardinal Vowels is not equally observed in EE.

Fig. (13) also illustrates that EE front vowels are extremely or fully front, whereas its back vowels are less back and rounded than RP vowels. This might be physiologically justifiable. The tongue movement from over-front vowels to over back vowels (similar to back cardinal vowels and some English-fully round and back vowels) would not be very convenient. Thus, for ease of articulation, EE back vowels are less round and back. This is in line with other tongue movements manipulated and adjusted to act smoothly and effortlessly. Moreover, the majority of EE consonants are believed to be front produced with the tip or blade of the tongue touching, approaching or approximating the back of the upper teeth, the alveolar ridge or lying interdentally. The assumption is that tongue assumes a number of movements that make it easy for it to move from one extreme to the other smoothly to achieve articulation ease. Such an assumption is confirmed cross-linguistically. Clark and Yallop (1996:

87) point out that tongue movements and positions are largely determined by neuromuscular commands. Concerning EE vowels, it might be proposed that tongue is usually given a command to move forward – even extremely forward-and when a command to move back or to activate the back section of the tongue is given, the back of the tongue does not precisely reach the position required for the "proper" pronunciation of English back vowels. Alternatively, similar vowels which are not "very back and round" are produced. This does not apply to RP vowels. The "moderately" front RP vowels make it possible, and even easy, for the tongue to produce full-fledged back, round vowels.

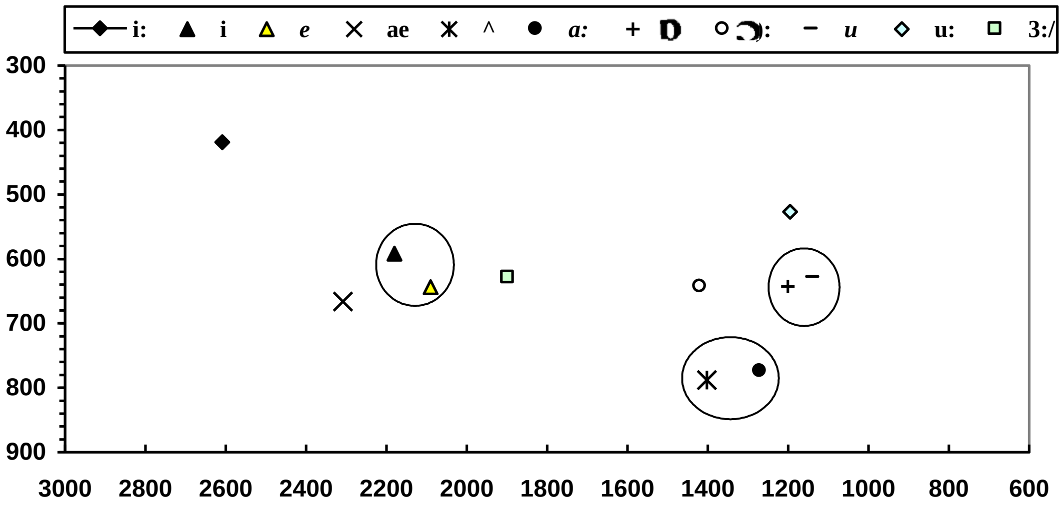

Fig. (13): F1 and F2 of all EE vowels and possible mergers/overlaps

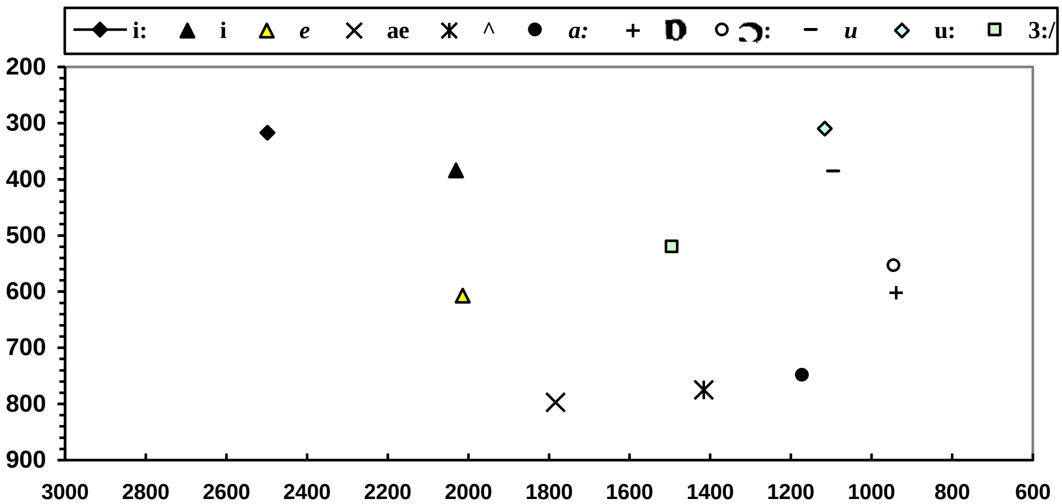

Fig. (14): F1 and F2 of all RP vowels

Table (24): Average vowel duration figures in EE and RP.

	Words	Group	N	Mean	Std. Deviation	T	Sig. Level
1	Bit	G1	13	87.38	15.14	1.139	Non sig.
		G2	3	97.67	4.04		
2	Bid	G1	13	99.31	14.80	5.849	Sig. at 0.01
		G2	3	150.67	1.15		
3	Bet	G1	13	91.62	20.46	2.361	Sig. at 0.05
		G2	3	129.67	43.82		
4	Bed	G1	13	93.69	15.06	7.765	Sig. at 0.01
		G2	3	173.33	20.82		
5	Bat	G1	13	195.62	44.60	0.124	Non sig.
		G2	3	199.00	27.07		
6	Bad	G1	13	196.92	24.99	3.345	Sig. at 0.01
		G2	3	253.00	32.36		
7	Cut	G1	13	94.77	19.24	2.873	Sig. at 0.05
		G2	3	127.67	4.04		
8	Bud	G1	13	110.23	24.81	3.012	Sig. at 0.01
		G2	3	154.67	4.51		
9	Pot	G1	13	109.54	18.15	1.721	Non sig.
		G2	3	128.33	7.64		
10	Cod	G1	13	114.31	30.67	3.389	Sig. at 0.01
		G2	3	183.33	37.86		
11	Put	G1	13	120.00	57.44	0.486	Non sig.
		G2	3	136.67	15.28		
12	Wood	G1	13	199.38	63.14	0.314	Non sig.
		G2	3	187.00	51.74		
13	Beat	G1	13	170.92	36.82	1.160	Non sig.
		G2	3	205.33	82.86		
14	Bead	G1	13	190.15	59.70	2.219	Sig. at 0.05
		G2	3	276.00	64.47		
15	Heart	G1	13	207.00	48.39	0.016	Non sig.
		G2	3	207.15	54.37		
16	Hard	G1	13	210.46	53.63	2.436	Sig. at 0.05
		G2	3	288.67	18.04		
17	Caught	G1	13	187.00	45.29	1.514	Non sig.
		G2	3	143.67	4087		
18	Cord	G1	13	24.15	67.88	1.327	Non sig.
		G2	3	269.33	42.91		
19	Root	G1	13	236.77	48.50	1.163	Non sig.
		G2	3	198.33	67.14		
20	Rude	G1	13	228.92	56.89	2.357	Sig. at 0.05
		G2	3	309.33	21.13		
21	Hurt	G1	13	203.54	64.36	0.971	Non sig.
		G2	3	166.33	14.84		
22	Heard	G1	13	215.46	63.97	0.649	Non sig.
		G2	3	245.00	103.92		

Thus, the reconstruction process of RP vowels to EE vowels is determined by L1 influence, orthography, sound intrinsic phonological difficulty, EE learners' self-consciousness and attitudes. The following are two lists (1) includes RP vowels and (2) comprises RP vowels after undergoing a process of reconstruction, determined by the factors mentioned above, to EE vowels.

[1] $\xrightarrow{\text{Recontructing to}}$ → [2]

[i:] → [> i] Fronter, lower and shorter before voiced consonants.
v

[i] → [< i] Slightly fronter, lower and shorter before voiced consonants.
v

[e] → [e] Similar to RP [e], only slightly shorter before voiced consonants.

[æ] → [<æ̂] Fronter, higher and slightly shorter before voiced consonants.

[^] → [^] Similar to RP [^], only slightly shorter before voiced consonants.

[*a*:] → [*a*] Similar to RP [*a:*], only slightly fronter and shorter before voiced consonants.

[ɒ] → [<ɒv] Lower, less back and shorter before voiced consonants.

/ɔ:/ → /<ɔv:/ Lower, less back and less rounded

/ʊ/ → $/\overset{<}{\underset{\text{v}}{\text{ʊ}}}/$ Lower and less back

/u:/ → $/\overset{<}{\underset{\text{v}}{\text{u:}}}/$ Lower and less back

/3:/ → $/\overset{<}{\underset{\text{v}}{\text{3:}}}/$ Fronter and lower

/3:/ → /**ɒ**/ as in “work”

/3:/ → /i/ as in “girl”

/3:/ → /ʊ/ as in “burn”

RP vowels, reconstructed to EE vowels, become autonomous as articulated by phonologists, L2 theorists and diachronic linguists (outlined above). Such autonomous, newly reconstructed vowels, possess phonological representations of their own: underlying and phonetic/surface rerpesentations. Seen from generative perspectives, the newly reconstructed forms represent the underlying representations which undergo a number of phonological rules of their own to surface as phonetic representations. Such rules explain some vowel related phenomena such as vowel reduction, vowel insertion and vowel disappearance. The following section presents an investigation of such phenomena with a view to understanding the surface phonological representations of EE vowels.

3.2. Some RP and EE vowels phonological rules

3.2.1. Vowel reduction:

The status of /∂/ has triggered heated controversies among phonologists. Its very existence has been widely questioned. Conventionally, /∂/ is commonly described as the most frequent vowel in English, appearing exclusively in weak, unstressed syllables where it represents a reduction of strong vowels. Gimson (1980: 127) contends that vowel-reduction rule is typical of stress-timed languages such as English, and it is traced back to old English, through Middle, up to Present-day English. Clark and Yallop (1996: 88) echo the same view indicating that it is the rhythmic nature of English which necessitates the alternation between the stressed and unstressed syllables accompanied by a fast rate of speech that explains the frequent occurrence of /∂/ in English. They also maintain that, in rapid connected speech, the tongue “tends to assume a more central or neutral position, effectively smoothing or summing the mechanical consequences of the individual movements”. It is this central, neutral position where /∂/ is produced. To generativists and lexical phonologists /∂/ is not a distinctive segment of English vowels. Chomsky and Halle (1968: 120) state that “the exact phonetic realisation of /∂/ does not concern us”, turning their attention to its unique role in vowel reduction rule. Vowel reduction, for them, is determined not only by the functioning of the underlying grammatical rules, but also by a variety of other factors (speed, casualness, frequency of the use of the item, predictability in a particular context, etc.) These factors interact in complex and not very well-understood ways to determine the extent and place of vowel reduction; and they result, as well, in many other modifications of underlying grammatically-determined forms (slurring, consonant elision, etc.). Chomsky and Halle formulate a set of vowel reduction rules which generate the surface reduced forms from their underlying origins. These rules apply first within morphemes, then within words, then within phrases and so on. Vowel reduction rules represent a perfect model for the cyclic rule application. The reason is simple: vowel reduction is associated with stress, and stress rules apply cyclically in English[13].

In their discussion of Trubetzkoy's view)zof neutralization which refers to the suspension of some phonetic oppositions under certain conditions, Clark and Yallop (1996: 111 ff) indicate that neutralization falls into three kinds. The first kind occurs when "a language has a certain contrast but only one of the relevant phonemes occurs under neutralization". A cited example is in a language where a contrast is maintained between voiced and voiceless plosives in only word initial and medial positions, while this contrast is suspended word-finally where only voiceless plosive phonemes appear. Consequently neutralization applies only word-finally. The second kind has to do with some variation or alternation among contrasting phonemes. A case in point is the preconsonantal nasals in Indonesian which take the point of articulation of the following consonant which must be homorganic. So only consonant sequences such as /nd/ and /mb/, which are homorganic, are permissible. This means that there is no contrast of nasal consonants preceding the plosive and that the value of the preconsonantal nasal is "entirely predictable from the point of articulation of the following plosive." The third kind of neutralization is materialized in "a sound which is distinct from both of the otherwise contrasting phonemes." A frequently-cited example is when the vowel contrasts are reduced to the neutral vowel /∂/ under such conditions as occurring in stressed syllables and before certain consonants. All English vowels undergo such reduction and surface as /∂/. This is a corollary of the suspension or neutralization of contrasts in sounds, feeding weakening rules which despecify segments for the feature in question (Kiparsky, 1997: 660). For an exposition of this point, examine the words "repeat" /ripi:t/ and "repetition" /rep∂tiʃn/, /i:/ in "repeat" is a contrastive marked, strong, stressed vowel which is weakened in "repetition" due to stress shift to the unmrked, neutral, unstressed uncontrastive /∂/. Thus weakening under certain conditions breeds neutralization which refers to the suspension of the contrastive features of the sound. Such suspension leads to temporary underspecification of the segment by eliminating or, at best, “not specifying” its trivial, inherent features (Steriade,1997).

Four possible approaches of treating neutralization in phonological analysis are commonly proposed. The first is to treat the neutralized segment as an allophone or a phoneme, dismissing the notion of neutralization. This goes in line with the non-generative phonologies. The second, suggested by Trubetzkoy, (cited in Clark and Yallop, 1996) entails that English /∂/ might be judged to be an archiphoneme representing the neutralization of vowel contrasts exhibited in stressed syllables. It is not identified with any of the other vowel phonemes but represents a suspension of the relative contrasts. The third one is to figure out the vowel to which /∂/ is assigned from related forms (e.g. /∂/ in “England” is assigned to /æ/ in land. In this connection, Roach (1983: 76) postulates that spelling can help. He provides ten forms representing /∂/ and the corresponding strong vowels to which /∂/ is assigned(14). The fourth approach is postulated by generativists. Their arguments is that the ‘strong” forms listed above represent the underlying forms which undergo vowel reduction derivation rule, typical of English, and ultimately surface as /∂/ (e.g. Chomsky and Halle, 1968, Simo Bobda & Chumbow, 1999, among others). Such a generative treatment of /∂/ in phonological analysis receives a widespread recognition as it traces /∂/ down to its underlying origins.

The acoustic analysis of /∂/ in EE shows that it is semi absent. The F1, F2 and duration of the examined vowels which should be realized as

/∂/ indicate that the vast majority do not undergo a vowel reduction rule as their RP counterparts (Table 25).

Example	F1	F2	Duration
about	650	2010	120
oppose	612	1109	103
suppose	760	1412	91
forget	620	1290	215
survive	590	2091	90
ballad	560	1950	90
open	580	2040	88

Examination of the figures in Table (25) show that /∂/ in EE is reconstructed in the light of the spelt forms. The English /∂/, which is the surface representation of the underlying /ɒ/, /3:/, /æ/, /ɔ:/ etc, is an output of the application of vowel-reduction rule. On the other hand, the vast majority of the would be /∂/ forms in EE do not undergo such a rule and surface in their strong unreduced forms. The question to be raised is: "Does vowel reduction rule apply to Egyptian English?" Data provide a positive answer. Nevertheless /∂/ is pronounced in a quasi-RP fashion in such words as "ballad" and "open" ([15]). Possibly /∂/ surfaces in EE when the syllable in which it occurs is extremely weak as in "ballad", and when it replaces the vowel /i/ as in "open" .

The majority of unstressed vowels in the study data are not reduced. RP /∂/ is reconstructed to EE /i/, /^/, /ɔ:/, /ɒ/ and /ʊ/ as in 'survive', 'suppose', 'forget', 'oppose' and 'purpose' respectively. Many non-native varieties exhibit the same process. The so-called French English, German English, Cameron English, Nigerian English as well as other South Asian Englishes are frequently-reported examples. This is attributed, as MacCarthy (1978: 65) states, to lack of knowledge of the /∂/ quality, either because it is not a mother tongue segment or because it is misleading, Latin-based English spelling system gives no pronunciation clues. MacCarthy maintains that despite the fact that /∂/ exists in German and French, it is not realized in the English spoken by German or French learners. MacCarthy explains:

> … in a great many cases the foreign speaker even though he may be quite capable of getting his tongue into the right position and so of producing the right quality of sound does not do so because he does not try to do so since he can not till from the spelling when /∂/ is the sound he should pronounce; so he proceeds to utter some other vowel that the spelling suggests to him.

Using the generative approach outlined previously and exposed perfectly in Simo Bobda & Chumbow (1999) a number of vowel related phenomena can be investigated. On top of which is vowel reduction. The study finding which states that /∂/ is not commonly used in EE, and that it is replaced by /ʊ/, /3:/, /æ/, /ɔ:/ etc. does not explain the reasons underlying such surface substitution. This is why the generative approach and basically the trilateral process proposed by Simo Bobda & Chumbow mentioned previously, are in place. Applied to EE data, the trilateral process can be illustrated as follows:

Underlying representation	RP æ	Restructuring of RP underlying representation →	EE æ	Underlying representation
Derivation by rules of RP phonology (+vowel reduction)	↓		↓	Derivation by rules of EE phonology (-vowel reduction)
Surface representation	∂		æ	Surface representation

Fig. (15): The trilateral process(16)

(Based on: Simo-Bobda and Chumbow, 1999)

An example is:

Input RP	[æ] g∂u	$\xrightarrow{\text{Reconstructing to}}$	EE [æ] g∂u
Vowel reduction	[∂]g∂u		…
Output	[∂]g∂u		[æ] g∂u

The previous figure and example read that the underlying RP /æ/ which is an input to the foreign learner is reconstructed to underlying EE /æ/. Therefore, two autonomous underlying representations are available, each representing one variety i.e. RP /æ/and EE /æ/. Once such a reconstruction is over, each form is subject to the application of phonological rules typical of each variety. In the example cited, the reconstructed underlying EE /æ/, unlike RP /æ/, is not subject to the phonological rule of vowel reduction, since EE does not permit the reduction of vowels in unstressed syllable. Consequently, EE /æ/ remains unchanged whereas RP /æ/ undergoes a vowel reduction process.

Similarly, /∂/ in [o]ppose is an output of a vowel reduction process operated on the underlying [ɒ], unlike the reconstructed EE [ɒ] which is immune from reduction. /∂/ in s[u]ppose is also an output of the vowel reduction of the underlying RP /^/. On the contrary, the underlying reconstructed EE /^/ remains unchanged in the surface form. /∂/ in f[o]rget is also product of a reduction process to the underlying RP /ɔ:/ which is reconstructed to underlying EE /ɔ:/ remaining unreduced in the surface representation. /∂/ in s[u]rvive is another example of the reduction of the underlying RP /3:/, which, again, is reconstructed to EE

/i/ and sometimes to /ʊ/, guided by orthography and remains unchanged as the vowel reduction rule is not operative in EE.

Thus, the claim that /∂/ is substituted by /ɒ/, /i/, /æ/ or any other vowel in EE is not accurate and contradicts the phonological processes typical of each variety. As is clear from the discussion, the non-existence of /∂/ in EE is not a result of substituting RP /∂/ by a number of vowels (e.g. /3:/, /ɔ:/, /i/, /ɒ/, etc.) but a product of the blocking of a key phonological rule, namely vowel reduction.

3.2.2. Vowel insertion:

The same approach can be employed in explaining other vowel-related phenomena in EE. One phenomenon is vowel insertion . In EE, due to L1 influence, the /i/ vowel is inserted in three basic environments: before pre-initial /s/ in syllable onset, after the initial consonant in initial two consonant cluster onsets, and within final consonant clusters. According to Feteih (1988), it is not permissible in Arabic syllable onsets to be realized by a vowel or more than one consonant and if it happens as when, for example, an Arab speaker learns English, an /i/ vowel-like sound is placed initially. For instance, in the initial consonant cluster in “star” /st-/ is divided into two parts, the first consonant is preceded by an /i/ forming separate syllable /is/), while the second consonant /t/ constitutes the onset of another syllable. Likewise, the final three consonant cluster is leveled by inserting an /i/ vowel between the second and third consonants. Feteih (1988) points out that final two consonant clusters are permissible in Arabic-syllable coda, only word-finally not syllable-finally. The following are examples of vowel insertion process:

	RP	Reconstructing to	EE
input	start		star
vowel insertion	-		[i]star
output	star		[i]star

	RP	reconstructing to	EE
input	students		students
vowel insertion	-		Student[i]s
output	students		Student[i]s

3.2.3. Vowel disappearance:

Another vowel-related phenomenon is vowel disappearance, it applies when two or three unstressed syllables follow a stressed syllable, and the unstressed syllable immediately after the stressed syllable is dropped altogether:

An example is:

	RP	Reconstructing to	EE
input	intiristiηŋ		intiristiŋ
vowel reduction	int[∂]r∂sti ŋ		intiristiŋ
vowel disappearance	int[ ]r∂sti ŋ		-
output	intr∂sti ŋ		intiristiŋ

Other examples:

næt∫r∂l → næt∫[u]r∂l

mizr∂bl̠ → miz[i]r∂b∂l

4. DISCUSSION OF FINDINGS

4.1. Vowel length/duration

Consistent with previous findings (Monru, 1993), results show that all EE vowels are shorter in duration than RP vowels. Three observations should be made. The first observation is that the descending order of EE vowels is ʊ: >3: >*a*: >ɔ: >æ >i:. This contradicts the previous findings which suggest that /i:/ and */a:/* are the longest in the English vowels produced by Arab speakers. The second observation is that the descending order of the "short vowels" is ʊ > ɒ > ^ > e > i. This also goes consistently with the commonly-held view that the back vowels are relatively and generally longer than front vowels. On the other hand, RP vowels order in duration is u: > *a*: > i: > æ > 3: and ʊ > ɒ > e > ^ > i for long and short vowels respectively. The third observation is that results confirm the well-established fact that RP vowel length is determined, among other things, by the following consonant: voiced and/or voiceless. All RP vowels are lengthened before voiced consonants and shortened before voiceless consonants. Their differences in duration are definitely significant. On the other hand, the following consonant, voiced/voiceless, does not seem to influence the vowel duration in EE.

Examining the data more closely, it is suggested that EE speakers are quite conscious of the fact that length is a key factor in distinguishing between vowels. A quick glance at the duration values of the two groups indicate that there are no significant differences at 0.01 or 0.05 in the duration values of most of the vowels followed by voiceless consonants between the two groups. The ones showing differences, though not significant at 0.01 or 0.05, in favour of the RP vowels include "bet" and "cut". This indicates an over-consciousness of the shortening character of such vowels in comparison with their long counterparts. On the other hand, vowels in such words as “wood”, “caught”, “root” and “hurt” are longer in EE than in RP though three of them are followed by a voiceless consonant each. As far as “wood” is concerned, its /ʊ/ vowel is prolonged mainly due to the orthographs “oo”, this also applies to “root”. The prolongation of “hurt” and “caught” vowels are difficult to explain. However, one possible explanation is that the F1 and F2 frequencies of the vowel in “hurt” specify it to be mid-way in tongue height between the long vowels /ɔ:/ and /a:/, consequently the feature "+long" extends to it.

It is proposed that English vowel duration is reconstructed in EE in the light of a number of factors. One factor is L1 influence manifested in the extra-awareness of vowel length as a contrastive property due to the dichotomous nature of Arabic vowels: long vs short. The second factor is orthography. EE “wood” and “root” vowels are longer as the former is pronounced as /wu:d/ whereas the latter’s “oo” stimulate an extra length of the vowel /u:/.

Accordingly, and in line with the autonomous-system hypothesis, EE like all NNEs, develops the following rules of vowel length.

1. $V \rightarrow$ [-longer] / — [+voiced con.] #.
2. $V_{+\text{ long}} \rightarrow$ [- longer] / — [+voiced con.] #.
3. $V_{+\text{ long}} \rightarrow$ [- shorter] / — [-voiced con.] #.

(1) reads that a vowel does not get longer before a voiced consonant.

(2) reads that a long vowel does not get longer before a voiced consonant in EE.

(3) reads that a long vowel is not shortened when followed by a voiceless consonant.

4.2. Formant frequencies:

Results make clear a number of remarks. First, F1 frequencies of all EE vowels except /æ/ and /ʌ/ are greater than RP frequencies. This indicates that EE vowels are generally lower. Second, F_2 frequencies of all EE vowels, except "root" and "wood" vowels, are greater indicating that EE vowels are generally fronter. Some impressionistic statements reported in O'Connor (1980: 19) by El-Menoufy, suggest an overlap of /i/ and /e/, with /e/ being used for both. This claim and other reported cases of overlap or merger such as /æ/, and */a:/* and /^/ and /ɒ/ are tested. Results confirm that the first case of /i/ and /e/ overlap in EE, F1 and F2 frequencies of /i/ and /e/ are 596 and 664, and 2100-2080, respectively. The differences are so slight that an overlap is possible and justifiable. Concerning /æ/ and */a:/* overlap, results show that they are quite distinct. This also applies to /ɒ/ and /^/ overlap. Results also show further examples of possible overlap or merger. One is between /ɒ/ and /ʊ/: their F1 and F2 figures are very close. Another one is between /ɔ:/ and /ʊ:/ though there are slight differences in F1 and F2 frequencies. Furthermore, /^/ and */a:/* in EE are rather distinct. F1 and F2 frequencies show that both are low/open in tongue height. However, tongue advancement is greater in /^/ than /*a*:/. Such a difference must be cautiously handled: results show that EE and RP /^/ versions are similar or close in space and in quality, yet a look at Fig. (14) shows that the distance in space between /^/ and */a:/* is greater in RP than in EE. Thus, a possible merger of */a:/* and /^/ in EE is justifiable. However, the two vowels are contrastive in length. This secures an extent of distinction between them.

Examining Fig. (13) reveals that all EE vowels are less back than their RP counterparts. Two findings might accordingly be reported. One is that there is a less degree of lip rounding in the pronunciation of EE vowels. It is commonly held that lip rounding has a lowering effect on higher frequencies (Sing and Sing, 1982, Watson *et al.*, 1998, among others), and hence, F_2 frequencies will be more affected than F_1 frequencies. A quick look at F_2 frequencies of back vowels in the two varieties implies that F_2 frequencies in RP vowels are significantly lower, suggesting a greater degree of lip-rounding during pronunciation. The second finding, germane to the first, implies that as all EE back vowels are less back and involve a less degree of lip rounding, this pushes them towards centrality as manifested in the centralized back vowels (Fig. 13) u:, ɔ, ɒ, ʊ and *a*:. The effect of such centrality continues till it reaches the front vowels making them fronter and lower. This goes in line with the Push—Chain theory by Bauer (1979) explained in Watson *et al.* (1998).

Another finding that emerges from the analysis is that there are three cases of mergers which vary in the extent of merging in EE. On top of these is /ʊ/ and /ɒ/, coming second is /i:/ and /e/, while */a:/* and /^/ come finally. Thus, the number of EE vowels can be reduced to eight in comparison with eleven in RP. Moreover, it can be claimed that EE and RP vowels differ in that EE vowels are less evenly dispersed in vowel space than EE vowels.

One further finding is that EE speakers experience less difficulty in pronouncing RP vowels similar to L1 vowels than in pronouncing new vowels with no L1 equivalents. Two key examples are /3:/ and /∂/, where the first is semi-absent and the second is quite absent. Such a finding is recurrent in a number of studies on NNEs (e.g. Fledge, 1993; Munro, 1993 and Wissing, 2002).

Phonologically, EE vowels, which act autonomously after a process of reconstructing RP vowels, seem to possess a set of phonological rules unique to them. One is the non-application of vowel reduction rule resulting in the pronunciation of strong vowels in all contexts. Another rule, EE seems to be immune of, is vowel disappearance. A third rule applied to EE and RP is vowel length, yet each applies it differently. In EE, vowel length is a contrastive feature where vowels are primarily distinguished on length basis not on vowel quality basis, unlike RP where tensity and laxity are the key determinants of vowel quality distinction. One further finding related to length is that, unlike RP, EE does not apply the rule of vowel lengthening before voiced consonants. One last phonological rule applicable in EE is vowel insertion before and within consonant clusters. Generatively treated, such differences are traced down to explore their underlying forms and the application or non-application of rules deriving ultimately the surface forms. This enables us to account for and interpret the surface differences between the two varieties.

The study findings should be treated in the light of its limitations. The study is bounded by three basic limitations: (1) it is mainly descriptive, though some prescriptive remarks are encoded; (2) it is confined to the investigation of simple, pure vowels including /∂/ and /3:/, and (3) as the EE study subjects are female university students commonly classified as mesolectals on the NNE continuum, the EE data studied do not represent all possible forms of EE spoken by other groups on the continuum: basilectals or acrolectals.

Results show that EE mesolectals, represented by the study university students, speak an interlanguage variety of English. The considerable divergences between the two studied varieties entail that the EE speakers examined conduct a process of "considerable reconstruction" of RP vowels to EE. How similar/dissimilar an NNE to an NE is determined by how much the reconstruction is. Basilectals, the beginners, would administer a "radical reconstruction" process, whereas the advanced/acrolectals' reconstruction of an NE sounds would be limited. The discrepancies between EE and RP vowels indicate that having good pronunciation is not an easy job for EE students, to achieve and that L1 phonological features and rules should be taken into consideration while teaching and training.

Pedagogically, it is traditionally believed that pronunciation as a component of the speaking skill is resistant to improvement. However, having good pronunciation is a much sought-after goal. Students generally set some goals to achieve by having good pronunciation including: achieving intelligibility internationally and intranationally, having high self-confidence, enhancing self-image, raising their awareness of the different English accents, etc. Improving pronunciation at both segmental and suprasegmental levels has been questioned. Rajadurai (2001) contends that pronunciation training at the segmental level is thought to be more profitable than at the suprasegmental level. A Malaysian student, quoted in Rajadurai, says:

> I can't change my rhythm and intonation now. May be If I had been taught English pronunciation in my early years … Moreover, I'm not sure I want to change my intonation and accent (13).

Two important remarks can be stated here. One is that teaching pronunciation should start as early as the child starts learning English. The second remark is that pronunciation training should be a continuous and extensive task students have to do to secure achieving as many aims, by having good pronunciation, as possible. In the light of this study the following suggestions may be made:

1. Students should be made aware of the reconstruction processes they make when they speak English. This allows them to know that their English is not “English”, rather it is “Egyptian English”.
2. Focussing on and discussing the factors conditioning reconstruction would help students to be conscious of the nature of these factors and their significance, particularly orthography and L1 influence. More specifically, students should be aware that they are at the mercy of such factors, and that they should set themselves free from them.
3. As for EE vowel inventory; special emphasis should be laid on the severely divergent forms e.g. /3:/ and /∂/. Equal emphasis should be devoted to the confusing sounds i.e. mergers /overlaps- [/ɒ/ and /ʊ/], [/e/ and /i/], [/^/ and /*a*/] and, to a less degree, [/ɔ:/ and /u:/]. Less emphasis is needed to get the rest of the vowels as close to the pronunciation of the English vowels as possible.
4. Students should recognize that English applies a number of vowel-related rules such as vowel reduction, length and disappearance, and they in turn should abide by these rules and not be prisoners of their EE rules.
5. It is true that there is a pervasive trend towards the international recognition of NNEs, yet achieving good, intelligible pronunciation is one of the dearest aspirations for most students.

This is why, pronunciation training is a key means to realize students' dream. The students' recognition of the fact that they are speaking Egyptian English, whose features are different from that of native English, and is an outcome of a reconstruction process of native English conditioned by a number of factors could help them to make plans for better pronunciation. These remarks, among others, call for extensive further work on how to help students fulfill such needs

Whether EE has a distinctive phonology is partially answered in this study. At vowels level, the answer is positive. Results obtained suggest that EE vowels have an inventory of their own, comprising only eight vowels, and that they apply phonological rules of their own. However, it is too early to conclude that EE has a distinctive phonology which makes it stand out against other NNEs. Much work has to be done before drawing such a conclusion. First, an instrumental study employing acoustic measurements of other EE segmentals (diphthongs and consonants) and suprasegmentals (stress, rhythm and intonation) is a prime need. Second, the samples selected should be representative of EE speakers at all levels: age, sex, occupation, English proficiency levels, etc. The current study is just a stepping stone on the path to achieve such a purpose.

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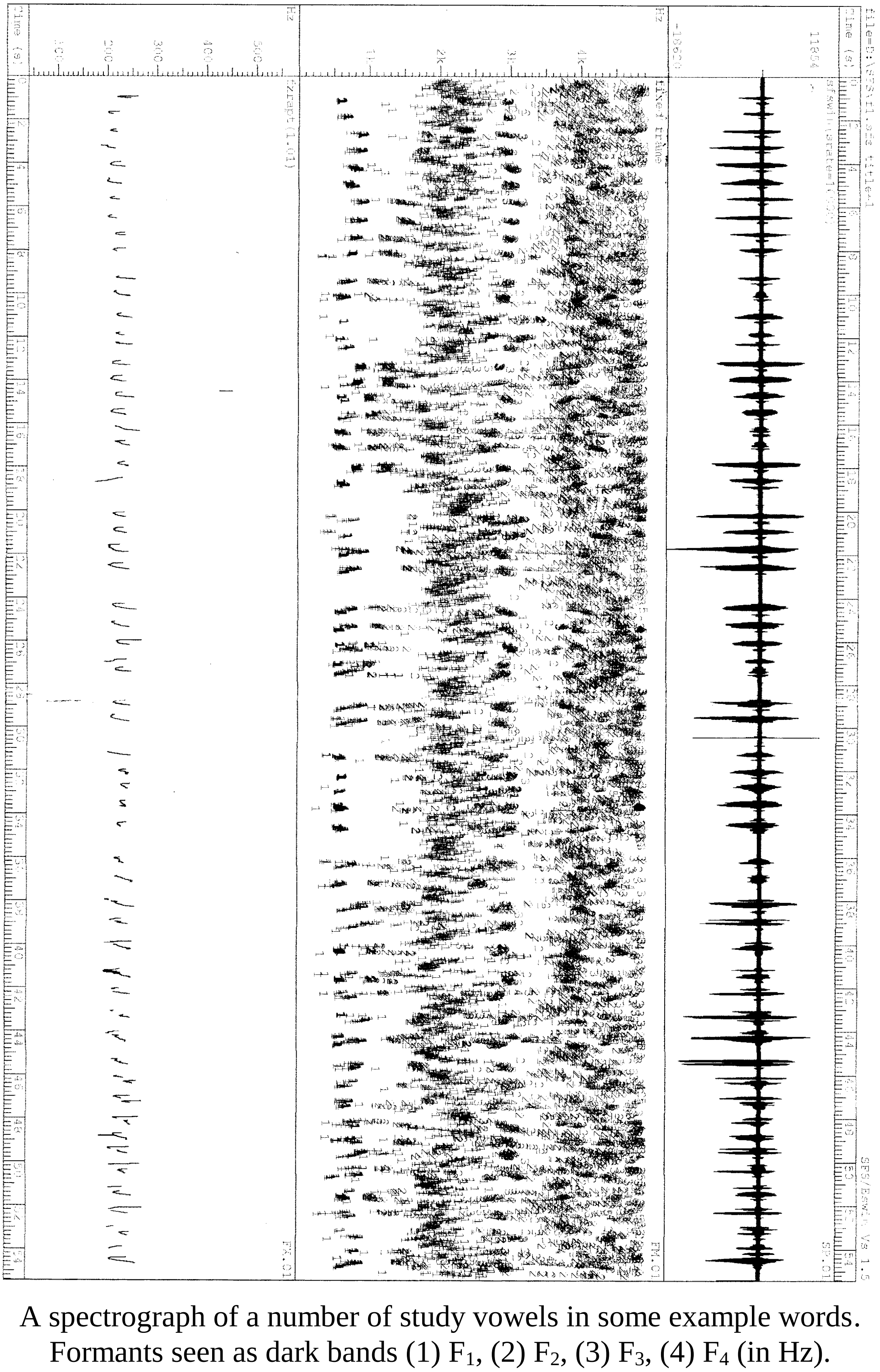
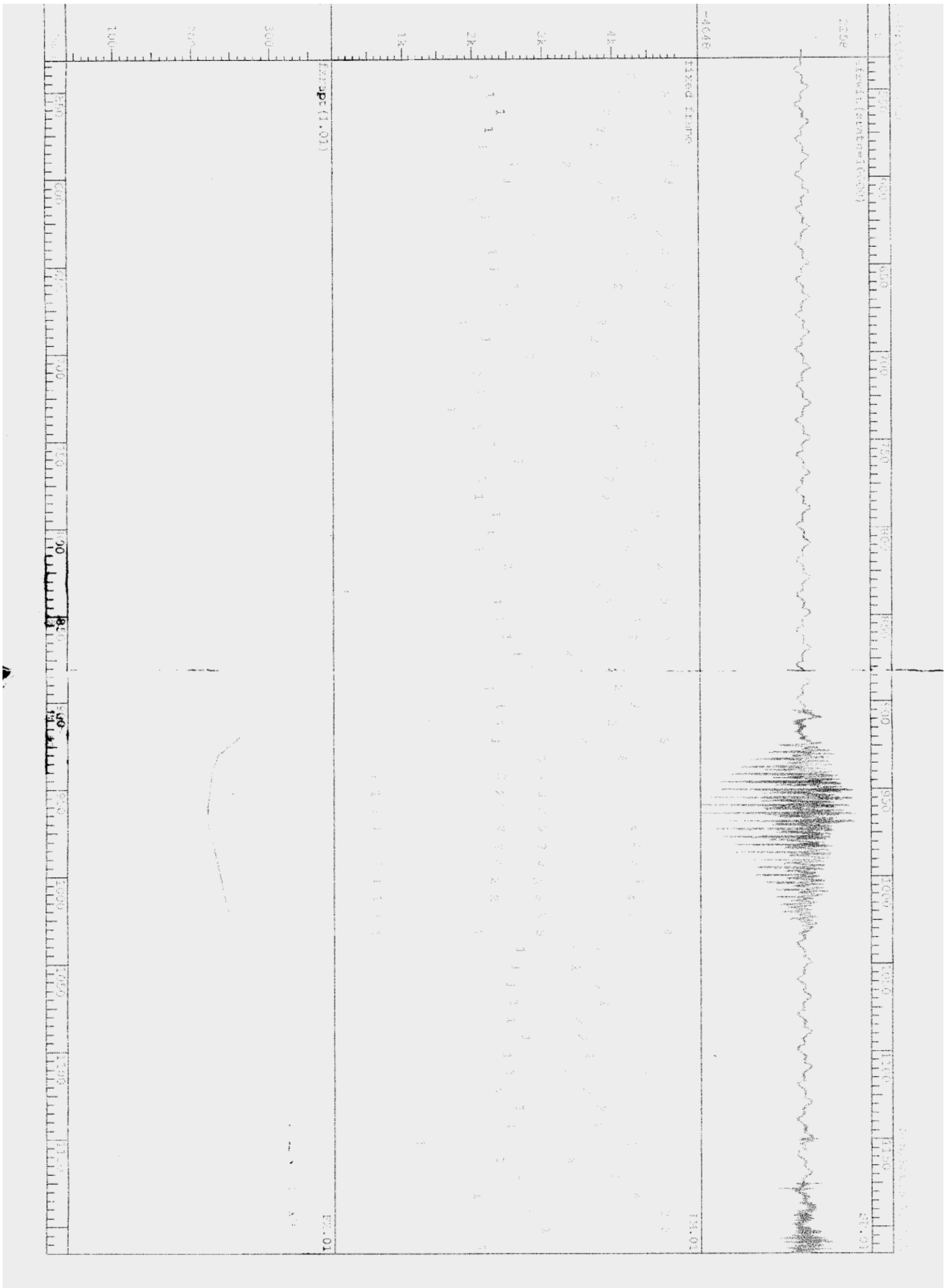
Appendix



A spectrograph of a number of study vowels in some example words.
Formants seen as dark bands (1) F_1, (2) F_2, (3) F_3, (4) F_4 (in Hz).



A spectrograph of the vowel of an example word.

ENDONOTES

([1]) It should be noted that such classification is impressionistic and needs further research.

([2]) Dinnsen (1999: 649-50) reports three substitution patterns: (1) substitution of glides for liquid consonants as in /w/ for /l/ eg. [wid] for "read" and [wif] for "leaf"; (2) substitution of plosives for fricatives as in [lipi] for "leafy" and [tu:t] for "tooth'; and [3] substitution of alvealars for "velars" as in [tidz] for "kids' and [dʌn] for "gun". In addition to substitution, phonological processes involve omission of final consonants. Common examples are: [kʌ] for "cup" and [bæ] for "bag".

([3]) For neogrammarians, Kiparsky (1997: 642) argues, sound change is an exceptionless, phonologically conditioned process rooted in the mechanisms of speech production". Sound change is seen as a corollary of a gradual articulatory shifts acting blindly and independently from the linguistic system.

([4]) The concept of critical period rests on the assumption that there is a period in childhood when the human brain is most ready to receive and learn a particular language.

([5]) Chs. 2 and 3 in SPE provide an extensive discussion of cycle in stress assignment in English.

([6]) Cole (1997: 70) maintains that the fact that classical generative phonology "highlights the instrumental role of morphological constraints on the application and formation rules leads to the development of the influencial theory of lexical phonology". Mohnan's (1997) article is devoted entirely to unfolding the interface between phonology and morphology.

([7]) See ch. 4 in SPE.

([8]) The Cardinal Vowel system, proposed by Daniel Johes showing the limits of possible vowel quality, consists of eight primary extreme vowels. In Cardinal Vowel (1) [i] the front of the tongue is as high and as forward as possible without causing audible friction, with lips extremely flat. Cardinal vowels 2, 3 and 4 are defined as front vowels that form a series of auditorily equidistant steps between 1 and 5. Cardinal vowel 5, on the other hand, is pronounced by the back of the tongue as low and as far back as possible. The lips are neutral. Likewise, Cardinal Vowels 6, 7 and 8 are all back vowels equidistantly ordered and accompanied by a mounting degree of lip-rounding. As such, all eight Cardinal Vowels are edge-vowels located at the outer sides of vowel chart, representing the outer limits of vocalic articulation. Several attacks have targeted the Cardinal Vowel system. Though acknowledging its importance in accounting for vowels in a wide variety of languages, Clark and Yallop (1996) argue that one problem with the Cardinal Vowels is that their values cannot be learned from written description. A second problem is that, they confuse articulatory and auditory properties. Jones' analysis of Cardinal Vowels and its reconcilement with his definition of equidistance cannot be made clear: Cardinal vowels 5, 6, 7 and 8 are much made closer than (2), (3), (4) and (5). A third problem with the Cardinal Vowel system has to do with the tongue height dimension. It is hypothesized that the position of the highest point of the tongue is not a valid indicator of vowel quality, rather "it is the location of the major constriction formed by the tongue, rather than the tongue height itself, which is a much more direct determinant of perceived vowel quality".

([9]) An acoustic comparison does not necessarily involve all items in all its stages. For example, the features of rounding, rhotasization and nasalization are used less frequently than tongue advancement and height, as the letters are primary features involved in the description and for the contrast between all vowels.

([10]) Among the diacritics commonly used with vowels are:
< fronted
> retracted
^ raised
v lowered
- centralized
. half long

([11]) Egyptian Arabic vowels are /i/, /u/, /e/, /o/, /*a*/, and /*a̲*/ and their long counterparts: /ii/, /uu/, /ee/, /*aa*/ /oo/, /*a̲ a̲*/

([12]) Figures in Table 17 show that Deterding's female subjects slightly raise /⊃:/ making it a bit closer than the study RP females.

([13]) For a complete discussion of cycle in phonology, the reader is referred to Chomsky and Halle (1968), Cole (1997), Iverson (1997), among others.

([14])
1. Spelt with 'a': strong pronunciation would have /æ/ as in attend /∂tend/.
2. Spelt with "ar" strong pronunciation would have /*a*:/ as similar /simil∂/
3. Adjectival endings spelt "ate" strong pronunciation would have /ei/ as in intimate /intim∂t/
4. Spelt with "o" strong pronunciation would have /ɒ/ as in carrot /kær∂t/
5. Spelt with "or" strong pronunciation would have /⊃:/ as in forget /f∂get/
6. Spelt with "e" strong pronunciation would have /e/ as in postmen /p∂ustm∂n/
7. Spelt with "er" strong pronunciation would have /3:/ as in perhaps /p∂hæps/
8. Spelt with "u" strong pronunciation would have /^/ as in support /s∂p⊃:t/
9. Spelt with "ough" as in thorough /θ^r∂/
10. Spelt with "ous" as in gracious /greiʃ∂s/.

([15]) One further question is "what are the phonological contexts which trigger the /∂/ surfacing?"

([16]) According to Simo Bobda & Chumbow the horizontal line in this figure represents the reconstruction of the underlying representation. In this case, RP /æ/ is restructured to EE /æ/. The left and right vertical lines refer to the process of derivation of the surface representations from underlying representations of RP and EE, respectively.