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Acquiring the Phonetics and Phonology of English Word Stress: Comparing Learners from Different L1 Backgrounds

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Abstract

This paper explores the acquisition of phonetic and phonological realisation of word stress, by Arabic speaking second language learners of English, in a small production study. Spoken Arabic dialects differ from each other in the phonology of stress, and the phonetic realisation of stress may also vary across dialects. In the present study the English speech productions of learners from two Arabic dialectal backgrounds (Cairo and Amman) is compared to permit disambiguation between L1 transfer and 'learner intonation' as the source of any non-native-like patterns in the phonological and/or phonetic realisation of stress. Phonetic realisation is investigated by means of quantitative acoustic analysis of read speech experimental data, with comparison to L1 Arabic and native English speaker control data. Phonological realisation is investigated by means of auditory qualitative analysis of read speech narrative data. No differences are found in the phonetic realisation of stress between the two Arabic dialects under consideration, however differences are found between the realisation of stress in Arabic as compared to English. In the L2 English production data, the results show a clear pattern of L1 transfer in the phonetic realisation of stress, in particular in lack of vowel reduction in unstressed syllables; this contrasts with

minimal errors in word-stress placement. The implications of the findings of the study for future research are briefly explored.

Keywords: stress, accent, Arabic, L2 English, acoustic cues, L1 transfer

There is a sizeable body of work on second language acquisition of the phonology of word stress (Archibald, 1994; 1997; 1997; Ghazali & Bouchhioua, 2003) – that is, the task of learning which syllable in the word should be stressed – but comparatively few studies have explored acquisition of language-specific patterns in the phonetic realisation of stress.

We seek to fill this gap by exploring, in a small production study, the acquisition of both aspects of word stress, by second language learners of English whose first language is Arabic. It is well known that spoken Arabic dialects differ from each other in the phonology of stress (Watson, 2011), and there are suggestions in the literature that the phonetic realisation of stress may also vary across dialects. In the present study the English speech productions of learners from two different Arabic dialectal backgrounds is compared; this approach should allow disambiguation between L1 transfer and ‘learner intonation’ (Mennen, Chen, & Karlsson, 2010) as the source of any non-native-like patterns in the phonological and/or phonetic realisation of stress.

BACKGROUND

Stress and Accent

In the present study, we use the term ‘stress’ to denote word-level prominence, whereby one syllable within a word is picked out and assigned metrical prominence (sometimes called lexical stress), and the term ‘accent’ to denote a phrase-level prominence, whereby one or more words within an utterance are picked out and assigned intonational prominence in addition to metrical prominence (sometimes called sentence stress). The position of stress within the word is strictly rule-governed in Arabic and is known to vary across dialects (van der Hulst & Hellmuth, 2010; Watson, 2011). The mechanisms governing the distribution of accent within an utterance in Arabic are less well understood, but the actual distribution of accents is known to vary across dialects (Chahal & Hellmuth, 2014).

In experimental studies, a confound between stress and accent has often been inadvertently triggered through use of single word stimuli. A single word utterance will bear the phonetic and phonological properties of a single word, but also of a whole utterance (Beckman & Edwards, 1994), thus there is no way to know whether any phonetic features observed are the hallmarks of word-level or phrase-level prominence. It is important to disambiguate the phonetic correlates of stress and accent however, because there is an overlap across languages in which cues are used at different levels: in Japanese f_0 is a cue to word-level prominence whereas in English f_0 is a cue to phrase-level prominence (Beckman, 1986).

Cross-Linguistic Variation in the Correlates of Stress

The phonetic correlates employed in production and perception of stress in English have been investigated in a number of studies, some of which suffer from the stress/accent confound. A classic perception study is Fry (1955; 1958), which relied on pairs of single word utterances as stimuli, and found that a hierarchy of correlates were relied upon by listeners: $f_0 > \text{duration} > \text{intensity}$. In contrast, in production, the most reliable cue to stress in English has been argued to be spectral balance (Sluijter, Shattuck-Hufnagel, Stevens, & van Heuven, 1995; van Heuven & Sluijter, 1996), as well as in a number of other languages (see Bouchhioua, 2008 for a review).

No perception studies of the correlates of stress or accent have been carried out in Arabic, to our knowledge. Some early production studies acknowledged the stress-accent confound (Chahal, 2001; de Jong & Zawaydeh, 2002). Recent work suggests however that there may be cross-dialectal variation in the phonetic correlates of stress. In Ammani Arabic f_0 , duration and intensity have been shown all to be correlates of stress (Zuraiq, 2005). In contrast, in Tunisian Arabic, f_0 , spectral balance and F1 lowering were found to be correlates of both stress and accent, whereas duration and intensity were correlates of accent only (Bouchhioua, 2008). The present study adopts the methodology of Bouchhioua (2008), which is designed to avoid the stress-accent confound by elicitation of target stimuli in carrier phrase contexts.

Second Language Acquisition of Stress and Accent

There is more prior work on the acquisition of the phonology of stress than on the acquisition of the phonetic realisation of stress. A number of studies report evidence of L1 transfer effects, in the form of placement of stress in the L2 according to the stress assignment rules of the L1 (Archibald, 1994; 1997). Other studies report that another source of non-native-like stress patterns is placement of stress on function words, which ordinarily in English would not receive stress (Ghazali & Bouchhioua, 2003). A study which did explore acquisition of the phonetic realisation of stress is Flege and Bohn (1989). Based on auditory assessment of stress placement and degree of vowel reduction, in the production by Swedish L2 learners of stress near-minimal-pairs in English, they argue that acquisition of phonological stress placement was less problematic than acquisition of phonetic realisation.

Turning to accent, some studies have found evidence of L1 transfer effects in the positioning of accents (Nava & Zubizaretta, 2008; Hellmuth, 2010), whilst others attribute similar patterns not to L1 transfer but to general properties of learner intonation (Mennen et al., 2010). There is also evidence of L1 transfer effects in the fine-grained phonetic realisation of accent (Mennen, 2004; Atterer & Ladd, 2004).

RESEARCH QUESTIONS

The aim of this study is to determine whether L1 Arabic learners of L2 English realise stress in a native-like way, a) phonologically (in terms of position of stress in the word, and appropriate treatment of lexical vs. function words) and/or b) phonetically (do the acoustic correlates of stress match those of native speakers). Our research questions are thus: (1a) what are the L1 correlates of stress in Jordanian Arabic (JA) and Cairene Arabic (CA)? and (1b) how do these compare to those observed in English?; (2a) do JA/CA learners of English realise stress in a native-like or non-native-like way? and (2b) how does this compare to their phonological accuracy (putting stress on the right syllable)?

Based on the results of prior studies, we expect to find that L1 Arabic speakers use f_0 to mark stress and accent, whereas L1 English speakers use f_0 to mark accent only. We expect to find vowel reduction in unstressed syllables in English but not in Arabic. In their L2 English, we expect our learners to display a greater degree of L1 transfer with respect

to phonetic realisation of native-like properties of stress, than with respect to phonological properties.

METHODS

Data Collection

We collected L1 Arabic and L2 English production data with four male intermediate or post-intermediate level L2 learners of English, two from Cairo, Egypt (CA) and two from Amman, Jordan (JA), as well as with two male native speakers of British English to serve as controls (NE). The Arabic participants were aged between 18-26 years; they had all learned English at school for 12 or more years, but none had resided in an English-speaking country for longer than one month. Recordings were made in Cairo, Amman and York, in quiet classrooms or offices, directly to.wav format at 44.1KHz 16bit, using a Marantz PMD660 and head-mounted Shure SM10 microphones. Use of head-mounted microphones permits investigation of comparative intensity across different tokens within the recording made by each speaker.

Materials

Disyllabic near minimal pairs, 12 in English and 12 in Arabic, were used to examine the effect of \pm stress in similar consonantal environments, following Bouchhioua (2008). Measurements are taken in the first syllable of the word, which is segmentally parallel in each pair, but differs in being either stressed or unstressed, as shown in Table 1.

In Arabic, the target vowel is varied systematically, with two near minimal pairs each to represent each of the main Arabic vowels /i i: a a: u u:/. The English stimuli mostly exploit the well-known stress distinction in noun-verb pairs. Note that these are not full minimal pairs, since the unstressed initial vowel is generally reduced to schwa in the verb. The English data are taken directly from Bouchhioua (2008); the Arabic stimuli follow the same pattern as used by Bouchhioua (2008) but using different lexical items, chosen because they are parallel across a range of spoken Arabic dialects.

Table 1. English and Arabic near minimal pairs, with stressed vs. unstressed first syllable.¹

<i>English</i>				<i>Arabic</i>			
<i>+stress</i>		<i>-stress</i>		<i>+stress</i>		<i>-stress</i>	
'sʌbdʒɛkt	subject (n.)	səb'dʒɛkt	subject (v.)	'bi:ra	beer	bi:'re:n	two beers
'rɛkɔ:d	record (n.)	rɪ'kɔ:d	record (v.)	'ba:ʃar	he preached	ba:'ʃar:t	I preached
'kɒntɹæst	contrast (n.)	kən'tɹæst	contrast (v.)	'bu:me	owl	bu:'ma:t	owls
'kɒmbaɪn	combine(n.)	kəm'baɪn	combine (v.)	'si:re	path	si:'na:t	sixes
'daɪdʒɛst	digest (n.)	dɪ'dʒɛst	digest (v.)	'sa:da	plain	sa:'da:t	gentlemen
'kɒntɹækt	contract (n.)	kən'tɹækt	contract (v.)	'su:ra	verse	su:'da:n	Sudan
'pɜ:mɪt	permit (n.)	pə'mɪt	permit (v.)	'sɪte	six	sɪ'ta:t	ladies
'pɜ:vɜ:t	pervert (n.)	pə'vɜ:t	pervert (v.)	'sattar	he covered	sat'tar:t	I covered
'ɒbdʒɛkt	object (n.)	əb'dʒɛkt	object (v.)	'sukkar	sugar	suk'ka:n	inhabitants
'kɒntɛnt	content (n.)	kən'tɛnt	content(adj.)	'kɪsbɪt	she earned	kɪs'bu:h	they earned it
'kɒndʌkt	conduct (n.)	kən'dʌkt	conduct (v.)	'marra	(one) time	mar'rart	I passed
'prɒdʒɛkt	project (n.)	pɹə'dʒɛkt	project (v.)	'mʊrra	bitter	mʊr'ri:n	passers-by

¹ In Arabic [-stress] targets (last column of the table), the initial unstressed long syllable will undergo phonological vowel shortening in CA but not in JA (Watson, 2002), yielding e.g. CA: [bi're:n]; JA [bi:'re:n]. This may affect the contribution of duration to the marking of stress.

In order to systematically vary accent status of the target word, we used carrier phrases designed to place the target in either a focussed [+accent] or post-focal [-accent] context, following Bouchhioua (2008). The basic carrier phrase for English was “say ____ again”, and for Arabic was /ʔuktub ____ kama:n marra/ ‘write ____ one more time’. To attract (focal) accent to the target word, a sentence containing a semantically related word preceded the carrier phrase with the target word. In order to deflect accent away from the target word, a sequence of preceding sentences is used so that the target word is given in context (repeated from earlier in the discourse) and highly likely to be deaccented (Cruttenden, 2006; Ladd, 2008).

Table 2. Target words (in bold) placed in carrier phrases to vary ±accent status.²

+accent	Say TOPIC again. Say SUBJECT again.
-accent	The subject is a grammatical category. WRITE subject again. SAY subject again.
+ accent	ʔuktub xamsa kama:n marra ʔuktub ' sitta/sit'taat kama:n marra <i>‘Write five another time, write six/sixes another time’</i>
-accent	sitta kalima sahla ʔuktub sitta kama:n marra Si:d ' sitta/sit'taat kama:n marra <i>‘Six is an easy word. Write six another time, REPEAT six/sixes another time.’</i>

This yields a 2x2 study in which both ±stress and ±accent are systematically varied, as in 1).

- | | | |
|----|--|--------------------|
| 1) | +accent | -accent |
| | +stress 'sitta ‘SIX (not five)...’ | REPEAT 'sitta... |
| | -stress sit'taat ‘LADIES (not men)... | REPEAT sit'taat... |

To assess phonological acquisition, each learner was asked to read aloud a 300-400 word excerpt from the Cinderella story, taken from the IViE corpus (www.phon.ox.ac.uk/IViE/).

² Capitalisation was used in the English written prompts to attract focus. There is no directly parallel typographical equivalent for use in Arabic.

Analysis

The experimental data comprise 12 lexical sets x 2 stress conditions x 2 accent conditions x 2 speakers, potentially yielding a total of 96 tokens per speaker/language dataset. There were no recordings errors or disfluencies in the Arabic speech recordings (N=192). In the English data, 45 tokens had to be excluded from analysis (N=288): 6 due to devoicing of the unstressed syllable; 39 due to realisation of stress on the wrong syllable (JA=5; CA=33; NE= 1).

The target vowels were labelled manually in Praat by the first author. The target vowels are preceded and followed by a stop, a fricative, a nasal, or /r/. Most vowels can reliably be segmented in these consonantal contexts (Turk, Nakai, & Sugahara, 2006). The primary cue used during segmentation was the appearance of a complete set of dark bands (formants) in the spectrogram, indicating the onset/offset of the vowel (Di Paolo, Yaeger-Dror, & Wassink, 2010, p. 91). The release burst of post-vocalic voiced stops was taken as the onset of the stop and thus the end of the preceding vowel, but aspiration following voiceless stops was not measured as part of the vowel. For fricatives, the onset and offset of frication energy was used to identify the beginning and end of the vowel, and nasals are also identified via abrupt spectral changes (Turk et al., 2006). Lowering of F3 and amplitude drop off were used to identify the onset of /r/ (Lawson, Stuart-Smith, Scobbie, Yaeger-Dror, & Maclagan, 2010, p. 79). The duration of the whole target word was also labelled, to provide a domain against which to normalise vowel duration and thus control for speech rate variation.

A sample labelled file is provided in Figure 1. A Praat script written by the third author was used to extract the following measurements: target vowel duration (divided by target word duration to normalise for speech rate), overall intensity (measured at the intensity peak [IP] within the target vowel, identified and labelled automatically), f0, F1, F2 and spectral balance measured at the midpoint [MP] of the target vowel (also labelled automatically). A manual check of pitch and formant tracking in all tokens was performed prior to running the measurement script. Two measures of spectral balance (H1-H2 and H1-A3) were measured using a script made available by Bert Remijsen (van Heuven & Sluijter, 1996).

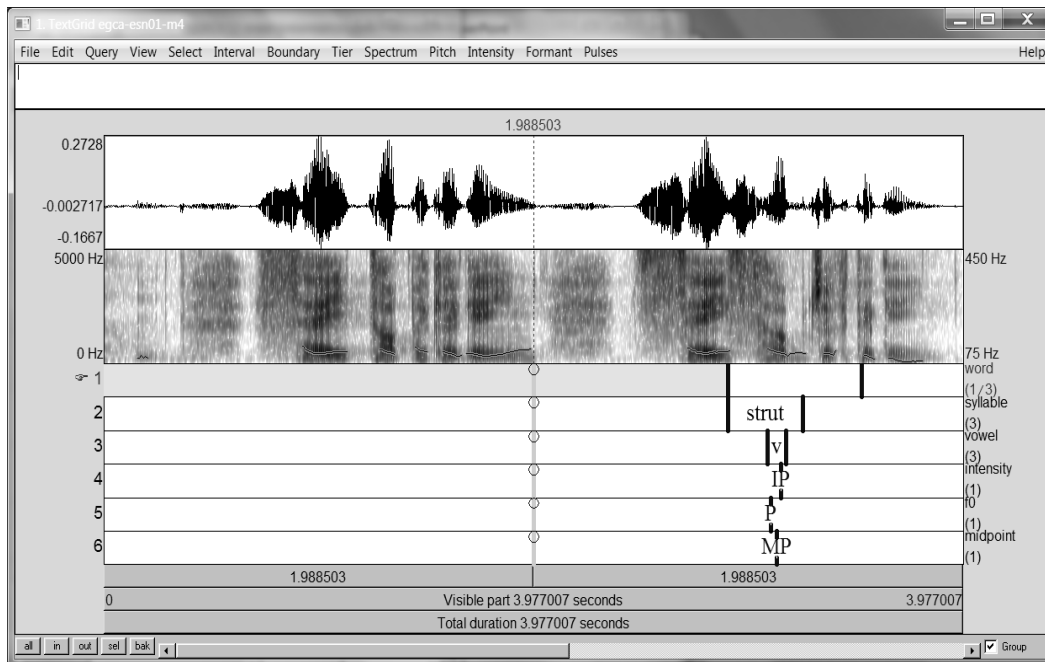


Figure 1. Sample labelled textgrid indicating measurement points of dependent variables.

The quantitative data were submitted to statistical analysis in a series of linear mixed models for each dependent variable, with *subject* and *item* as random factors, and *stress*, *accent* and *speaker language* as independent variables. Dependent variables were: duration, intensity, f0, two measures of spectral balance (H1-H2 and H1-A3), F1 and F2.

The narrative data were subjected to double blind error analysis by the second and third authors, based on auditory impression. Errors were classified into categories, according to type, such as stress placement on the wrong syllable or erroneous stress placement on a non-contrastive function word. Inter-transcriber agreement was 99.77%. No statistical tests were performed on the narrative data due to the relatively small sample size (1228 words in total).

RESULTS

We present results for each of our research questions in turn. To recap, our research questions are: (1a) what are the L1 correlates of stress in Jordanian Arabic (JA) and Cairene Arabic (CA)? and (1b) how do these compare to those observed in English?; (2a) do JA/CA learners of English realise stress in a native-like or non-native-like way? and (2b) how does

this compare to their phonological accuracy (putting stress on the right syllable)?

L1 Arabic correlates of stress in JA and CA, with comparison to L1 English

The results suggest that there is only a marginal difference between the two dialects, JA and CA. We found a main effect ($p < .05$) of *stress* on duration, intensity and f_0 , but not on F1, F2 or spectral balance (this latter result differs from that observed for Tunisian Arabic by Bouchhioua 2008). There was a main effect ($p < .05$) of *accent* on duration and intensity only, and none on f_0 , F1, F2 or spectral balance. This indicates that in both dialects stressed vowels are longer, louder and realised at a higher pitch than unstressed vowels; neither dialect uses f_0 as a cue to differentiate accented/unaccented vowels. There is a near significant interaction between *speaker_language* and *stress* for duration and f_0 [duration: $F(1,171)=2.975$; $p=.086$; $f_0:(1,167)=3.196$; $p=.076$]. Stressed vowels are somewhat more lengthened with respect to unstressed vowels in EA than in JA (Fig. 2a) ; in contrast, stressed vowels are realised with somewhat greater f_0 than unstressed vowels in JA than in EA (Fig. 2b).

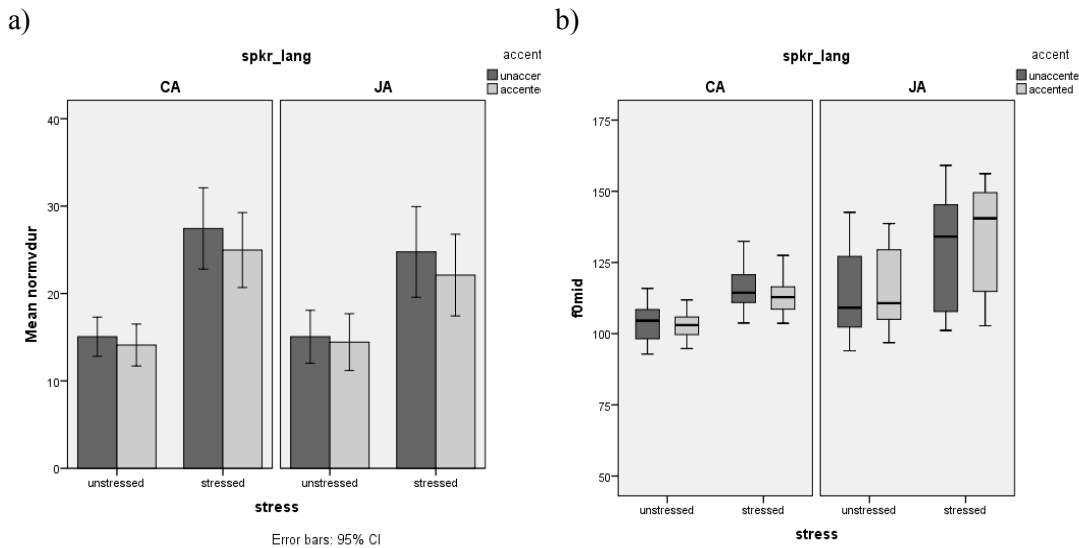


Figure 2. a) 95% confidence intervals around mean normalised target vowel durations in L1 Arabic, by dialect, stress and accent, and b) median and interquartile ranges of f_0 at midpoint of the target vowel in L1 Arabic, by dialect, stress and accent.

The key differences between Arabic and English in the phonetic realisation of stress are thus that, in Arabic, f_0 is used to mark (word-level) stress, not (phrase-level) accent, and F1/F2 are not used at all to mark stress. In contrast, in English, f_0 is primarily a cue to (phrase-level) accent in English, and vowel reduction, reflected in F1/F2, is a strong cue to (word-level) stress. Both patterns are observed in our own NE control data (see Fig. 3 and Fig. 5c below).

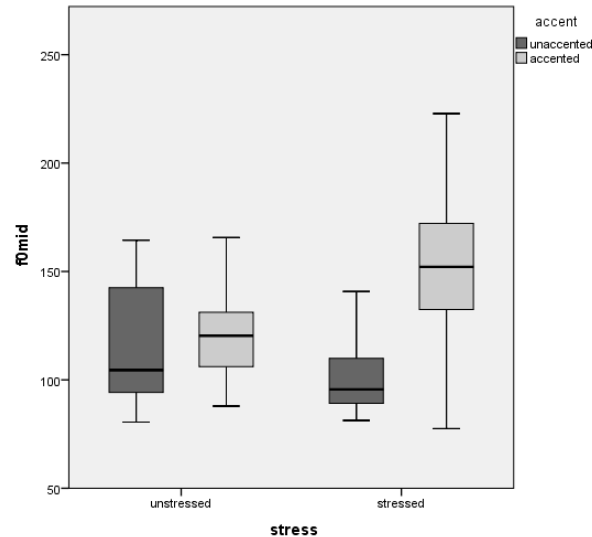


Figure 3. Median and interquartile ranges of f_0 at midpoint of the target vowel in L1 English, by stress and accent.

Phonetic Realisation of Stress in L2 English with Comparison to Phonological Error Rates

In light of the above result, an eventual L1 transfer effect in the phonetic realisation of stress in our participants' L2 English is expected to be manifested in use of f_0 to mark stress instead of accent, and in a lack of use of F1/F2 to mark stress, and this is indeed what we find.

We found an interaction of *speaker_language* and *accent* on f_0 [$F(2,240)=4.559$, $p=.011$], together with an interaction of *speaker_language*stress*accent* on f_0 [$F(3,240)=5.010$, $p=.002$]. The L2 learners use f_0 mostly to differentiate stressed/unstressed vowels whereas the NE speakers use f_0 mostly to differentiate accented/unaccented vowels (Fig. 4).

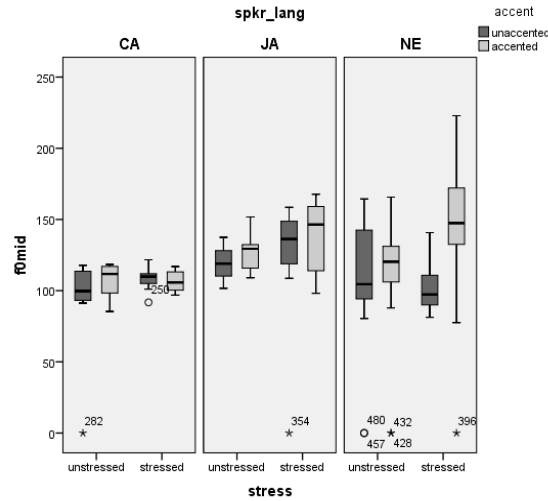
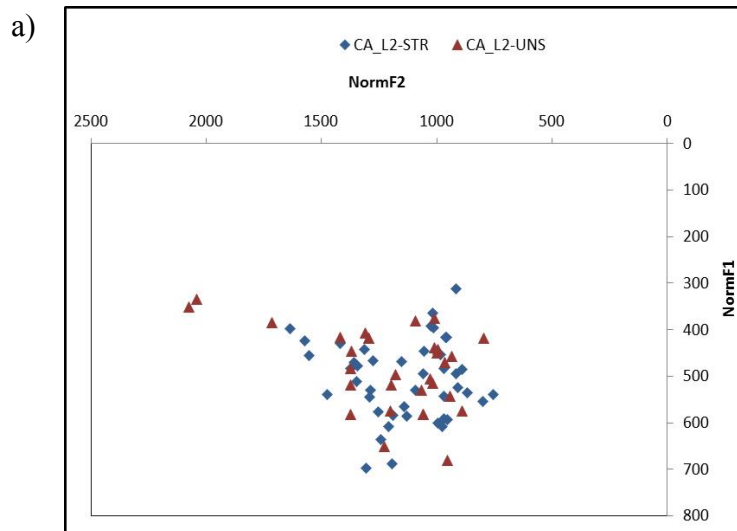


Figure 4. Median and interquartile ranges of f0 at the midpoint of the target vowel, by speaker_language, stress and accent.

We found an interaction of *speaker_language* and *stress* for intensity, F1 and F2 [intensity: $F(2, 242)=4.301, p=.015$; F1: $F(2, 242)=11.301, p=.000$; F2: $F(2, 242)=11.359, p=.000$]. A plot of normalised F1/F2 values shows considerable overlap in the distribution of stressed and unstressed vowels in the F1/F2 vowel space for both groups of L2 learners, in contrast to a clear separation of stressed and unstressed vowels by NE speakers (Fig. 5). There were no other significant interactions between *speaker_language* and other factors.



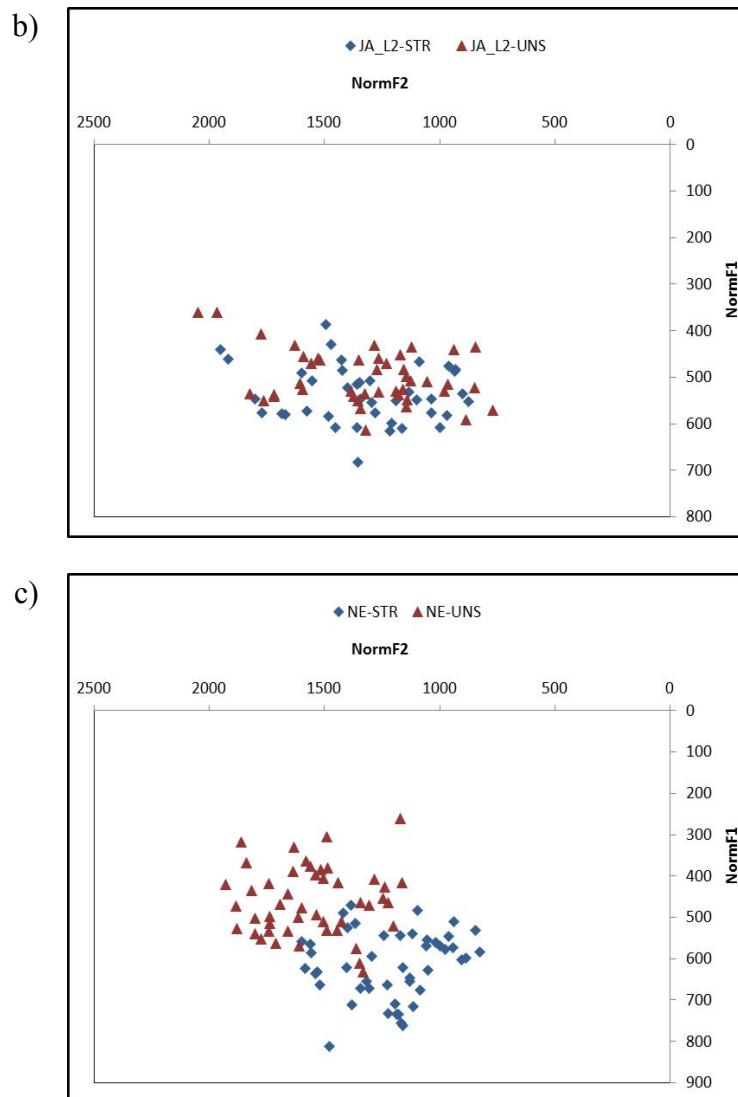


Figure 5. normalised F1/F2 measured at the midpoint in stressed (squares) vs. unstressed (triangles) target vowels in English for a) CA speakers, b) JA speakers, and c) NE speakers.

There is therefore some evidence of L1 transfer in the phonetic realisation of stress, in the speech productions of the L2 learners of English, in that the learners are marking stress in English with ‘too much’ f_0 and ‘not enough’ vowel reduction.

If we compare this to the learners’ phonological accuracy, in terms of categorical stress placement, we find a much smaller transfer effect. The results of the categorical error analysis are shown in Table 3. The error rate for each learner is very low (5% or less in all cases), and incorrect placement of stress within the word accounts for less than 10% of all observed errors. The main pattern of phonological transfer observed is in

assignment of (phrase-level) accent, the most common being non-native like placement of accent on a non-contrastive function word (cf. Ghazali & Bouchhioua 2003). Other non-native-like patterns include incorrect stress placement within a compound noun phrase and lack of deaccenting of words which are discourse-old.

Table 3. Categorical error types observed during auditory transcription of read speech data.

	# target words in text	within-word stress position errors	function word errors	compound errors	deaccenting errors	Total:
egca-m4	368	1	6	4	2	13
egca-m8	368	1	9	4	0	14
joam-m3	276	1	8	1	0	10
joam-m9	276	2	10	1	1	14
Total:		5 (10%)	33 (65%)	10 (20%)	3 (6%)	51

DISCUSSION

In summary then, the present study found no real difference in the phonetic correlates used to realise stress in CA vs. JA, but did show that the correlates of stress differ between the Arabic dialects explored here and British English. Stress is marked in Arabic (in the present data) by means of f_0 , duration and intensity, whereas stress is marked in English using duration and F_1/F_2 ; in English f_0 primarily marks (phrase-level) accent. In the experimental production data, the L2 learners were found to be marking stress in their L2 English productions with 'too much' f_0 and 'not enough' vowel reduction; they are marking accent with f_0 , but less so than NE speakers. In the read speech narrative production data, there was little sign of L1 phonological transfer in assignment of word-stress within words; the few errors that are observed are in the distribution of (phrase-level) accent.

The results support our hypothesis that we would find evidence of greater L1 transfer in the phonetic (gradient) realisation of stress than in its phonological (categorical) realisation. Some evidence of phonological transfer was observed, primarily in the form of non-native-like

assignment of accents to non-contrastive function words. This transfer could, in principle, be analysed as an effect of learner intonation (Mennen et al., 2010), though it is to be noted that the participants in the present study are well beyond beginner level.

The most salient phonetic difference between the L2 English and NE productions is the lack of vowel reduction in unstressed syllables as produced by the L2 learners. Teaching of unstressed vowel reduction is explicitly excluded from the Lingua Franca Core (Jenkins, 2002), however, it is possible that lack of vowel reduction in unstressed syllables would hinder identification of stress in these L2 productions by native English listeners. In a perception study, Taylor and Hellmuth (2012) found that some British English listeners were unable to identify the stressed syllable in disyllabic nonsense word stress minimal pairs when the stressed syllable was marked only with duration, intensity and f_0 , without reduction of the vowel in the adjacent unstressed syllable (cf. Cutler & Pasveer, 2006). The present study thus leads us to hypothesise that Arabic-speaking L2 learners of English will be able to identify the position of stress in our participants' production data, but that native English listeners may not be able to do so reliably. We hope to test this hypothesis in a future perception study.

REFERENCES

- Archibald, J. (1994). A formal model of learning L2 prosodic phonology. *Second Language Research*, 10, 215-240.
- Archibald, J. (1997). The acquisition of English stress by speakers of nonaccidental languages: Lexical storage versus computation of stress. *Linguistics*, 35, 167-182.
- Archibald, J. (1997). The acquisition of second language phrasal stress: a pilot study. *Language Acquisition and Language Disorders*, 16, 263-290.
- Atterer, M. & Ladd, D. R. (2004). On the phonetics and phonology of "segmental anchoring" of F_0 : evidence from German. *Journal of Phonetics*, 32, 177-197.
- Beckman, M. (1986). *Stress and non-stress accent*. Dordrecht: Foris.
- Beckman, M. & Edwards, J. (1994). Articulatory evidence for differentiating stress categories. In P. Keating (Ed.), *Phonological structure and phonetic form: paper in Laboratory Phonology III*. (pp. 7-33). Cambridge: CUP.
- Bouchhioua, N. (2008). *The acoustic correlates of stress and accent in Tunisian Arabic: A comparative study with English*. PhD thesis, University of Carthage.
- Chahal, D. (2001). *Modeling the intonation of Lebanese Arabic using the autosegmental-metrical framework: a comparison with English*. PhD thesis, University of Melbourne.
- Chahal, D. & Hellmuth, S. (2014). Comparing the intonational phonology of Lebanese and Egyptian Arabic. In S.-A. Jun (Ed.), *Prosodic Typology. Volume 2*. (pp. 365-404). Oxford: Oxford University Press.

- Cruttenden, A. (2006). The de-accenting of old information: A cognitive universal. In G. Bernini & M. L. Schwartz (Eds.), *Pragmatic organization of discourse in the languages of Europe*. (pp. 311-355). Berlin: Mouton de Gruyter.
- Cutler, A. & Pasveer, D. (2006). Explaining cross-linguistic differences in effects of lexical stress on spoken-word recognition. In R. Hoffmann & H. Mixdorff (Eds.), *Speech Prosody, 3rd International Conference, Dresden, May 2-5, 2006, Proceedings* (pp. 237-240). Dresden: TUD Press.
- de Jong, K. & Zawaydeh, B. (2002). Comparing stress, lexical focus and segmental focus: patterns of variation in Arabic vowel duration. *Journal of Phonetics*, 30, 53-75.
- Di Paolo, M., Yaeger-Dror, M., & Wassink, A. B. (2010). Analyzing vowels. In M. Di Paolo & M. Yaeger-Dror (Eds.), *Sociophonetics: A student guide* (pp. 87-106). London: Routledge.
- Flege, J. E. & Bohn, O. S. (1989). An instrumental study of vowel reduction and stress placement in Spanish-accented English. *Studies in Second Language Acquisition*, 11, 35-62.
- Fry, D. (1955). Duration and intensity as physical correlates of linguistic stress. *Journal of the Acoustical Society of America*, 27, 765-768.
- Fry, D. (1958). Experiments in the perception of stress. *Language and Speech*, 1, 126-152.
- Ghazali, S. & Bouchhioua, N. (2003). The learning of English prosodic structures by speakers of Tunisian Arabic: Word stress and weak forms. *Proceedings of the 15th International Congress of Phonetic Sciences*.
- Hellmuth, S. (2010). Accent distribution effects in L2 English: causes and implications. In K. Dziubalska-Kolaczyk, M. Wrembel, & M. Kul (Eds.), *Proceedings of the 6th International Symposium on the Acquisition of Second Language Speech, New Sounds 2010, Poznan, Poland, 1-3 May 2010*. (Oxford: Peter Lang.
- Jenkins, J. (2002). A sociolinguistically based, empirically researched pronunciation syllabus for English as an international language. *Applied Linguistics*, 23, 83-103.
- Ladd, D. R. (2008). *Intonational Phonology*. (Second Edition) Cambridge: Cambridge University Press.
- Lawson, E., Stuart-Smith, J., Scobbie, J. M., Yaeger-Dror, M., & Maclagan, M. (2010). Liquids. In M. Di Paolo & M. Yaeger-Dror (Eds.), *Sociophonetics: A student guide*. (pp. 72-86). London: Routledge.
- Mennen, I. (2004). Bi-directional interference in the intonation of Dutch speakers of Greek. *Journal of Phonetics*, 32, 543-563.
- Mennen, I., Chen, A., & Karlsson, F. (2010). Characterising the internal structure of learner intonation and its development over time. In *Proceedings of New Sounds 2010: The sixth international symposium on the acquisition of second language speech*. (University of Poznan.
- Nava, E. & Zubizarreta, M. L. (2008). Prosodic transfer in L2 Speech: Evidence from phrasal prominence and rhythm. *Proceedings of Speech Prosody 2008*, 335-338.
- Sluijter, A., Shattuck-Hufnagel, S., Stevens, K., & van Heuven, V. (1995). Supralaryngeal resonance and glottal pulse shape as correlates of stress and accent in English. *Proceedings of the 13th International Congress of Phonetic Sciences, Stockholm, 2*, 630-633.
- Taylor, B. & Hellmuth, S. (2012). Are English listeners 'deaf' to L2 stress? Paper presented at EURO-SLA, Adam Mickiewicz University, 5th-8th September 2012.
- Turk, A., Nakai, S., & Sugahara, M. (2006). Acoustic segment durations in prosodic research: a practical guide. In S. Sudhoff, D. Lenertová, R. Meyer, S. Pappert, P.

- Augurzky, I. Mleinek, N. Richter, & J. Schliesser (Eds.), *Methods in empirical prosody research* (pp. 1-28). Berlin: Mouton de Gruyter.
- van der Hulst, H. & Hellmuth, S. (2010). Word accent systems in the Middle East. In R.Goedmans & H. van der Hulst (Eds.), *A Survey of Word Accentual Patterns in the Languages of the World* (pp. 615-646). Berlin: Mouton de Gruyter.
- van Heuven, V. & Sluijter, A. (1996). Notes on the phonetics of word prosody. In R.Goedmans, H. van der Hulst, & E. Visch (Eds.), *Stress patterns of the world. Part 1: Background.* (pp. 233-269). The Hague: Holland Academic Graphics.
- Watson, J. C. E. (2002). *The phonology and morphology of Arabic*. Oxford: OUP.
- Watson, J. C. E. (2011). Word stress in Arabic. In M.Oostendorp, C. Ewen, E. Hume, & K. Rice (Eds.), *The Blackwell companion to phonology. Volume 5* (pp. 2990-3018). Oxford: Blackwell.
- Zuraiq, W. (2005). *The production of lexical stress by native speakers of Arabic and English and by Arab learners of English*. PhD thesis, University of Kansas.