Segmental and prosodic characteristics in the production and perception of non-native speech  
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The present study examines the role of segments and prosody in foreign accent perception. Although both prosodic and segmental characteristics have previously shown to influence the degree of proficiency, very little is known about their interaction in the perception of foreign accent (Boula de Mareüil & Vieru-Dimulescu, 2006; Jilka, 2007, Carmichael, 2000). Here, we present a detailed analysis of foreign accent ratings obtained from native English listeners. Stimuli for the perception experiment were created on the basis of the recordings of 90 L2 speakers of English. The L2 speakers were allocated three groups, i.e. beginners, intermediate and advanced learners of L2-English. The allocation into groups followed a placement test according to the Common European Framework (CEFR) into A1 and A2 as beginners, B1 and B2 as intermediate, and C1 and C2 as advanced learners of L2 English. In addition, we took the time of formal instruction in and exposure to English as a foreign language (EFL) into consideration (beginners <3 month, intermediate 1.5 years, and advanced > 3years).

We recorded German L2- and native speakers of English producing words and pseudo-words in isolation and context as well as two native English control speakers. Words and pseudo-words were chosen and designed according to a selection of phonological differences between the phonological systems of German and English and resulting mispronunciations in L2 produced by German native speakers:
- substitution: [θ] → [s]
- substitution [əʊ] → [o]
- truncation (German) vs compression (English)
- IP-final boundary tones in declaratives.

The speakers produced words in isolation (see examples 1). Pseudo-words were presented as names for objects that could easily be recalled and memorised. Subsequently, these (pseudo)-words were put into a context that allowed for the collection of near-natural but still directly comparable utterances and items. This was accomplished by a map-task speaker-pairs had to participate in. The obtained single words as well as a selection of directly comparable utterances from the discourse were segmented automatically on the syllabic and phonemic level and subjected to the acoustic manipulation of prosodic transplantation. The procedure allows for the separation of prosodic and segmental information in the speech signal so that combinations of native segments with non-native prosody and vice versa were created (Boula de Mareüil & Vieru-Dimulescu, 2006; Winters & Grantham O’Brian, 2012). The stimuli were rated by 60 native speakers of English in a forced choice paradigm (native vs non-native) followed by a confidence rating of their choice on a 3-point scale (certain, semi-certain, and uncertain). This resulted in an operational 6-point scale of foreign accent (FA rating) (de Leeuw, et al., 2010). Overall the results show that beginners’ productions received the highest and advanced learners the lowest FA ratings (see table 1). Crucially, the transplantation of native English prosodic characteristics onto L2 segments did not improve perceived foreign accentedness in the beginners (and the intermediate) group(s) of speakers, but did in the advanced group of speakers. Therefore, our results appear to confirm a previously suggested correspondence between segments and prosody (Correspondence Model in Ulbrich & Mennen, submitted). The model is based on the idea that along the continuum of heavily foreign-accented speech towards native pronunciation of a given target language, segmental and prosodic degrees of produced and perceived nativeness need to correspond with one another in order for small prosodic deviances to be perceived.
Examples 1
• 'tham', 'sem', 'sode', 'theatre', 'road', 'mode'

Examples 2
• 'Anne eats a tham.'
• 'John sat on the sem.'
• 'The fat woman is in the theatre'
• 'John likes to take the long road.'

Table 1: FA scores for the two types of manipulations (L2 segments with native prosody, L2 prosody with native segments) and original L2 segments and prosody.

<table>
<thead>
<tr>
<th></th>
<th>L2 segments/native English prosody</th>
<th>L2 prosody/native English segments</th>
<th>L2 prosody/segments</th>
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<tbody>
<tr>
<td>beginners</td>
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<td>3.4</td>
<td>5.2</td>
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<tr>
<td>intermediate</td>
<td>4.0</td>
<td>3.6</td>
<td>4.0</td>
</tr>
<tr>
<td>advanced</td>
<td>2.1</td>
<td>2.2</td>
<td>2.6</td>
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References: