A Cross-Language Comparison of the Use of Stress in Word Segmentation

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Background

Word boundaries in continuous speech are hardly acoustically marked. However, listeners use language-specific cues (e.g., lexical stress placement) to segment speech into words (for an overview, see Cutler, 2001).

How are listeners influenced by this native-language segmentation experience when confronted with an unknown foreign language?

French has final accent, and French listeners benefit from vowel lengthening and/or a pitch change on the final syllable of each word in an artificial language (Bagou et al., 2002). Dutch has mainly initial stress, and Dutch listeners benefit from a pitch rise on the first syllable of each word in an artificial language (Vroomen et al., 1998).

BUT: Can listeners benefit from regularities that are not familiar from their native language?

The Current Study

An artificial language of 9 randomly concatenated words was presented to French and Dutch adult listeners in 3 versions: with no stress vs. those with initial- or final-syllable stress (pitch excursion) on each word. An additional experiment tested Australian-English adult listeners (whose language, like Dutch, has initial-syllable stress).

Predictions:

- All groups: stress > no stress.
- Dutch and Australian: initial stress > final stress.
- French: final stress > initial stress.

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Method

French vs. Dutch Experiment	Australian Experiment
72 French Listeners (Dijon, France)	72 Australian Listeners (Sydney, Australia)
72 Dutch Listeners (Nijmegen, The Netherlands)

A pool of 30 diphone-synthesized (MBROLA) syllables from: 6 consonants (/p,b,m,f,s,k/) & 5 vowels (/a,ε,i,ɔ,u/), chosen to be as phonetically similar as possible between French and Dutch, were randomly allocated to words to create 24 unique languages, each of 10 minutes duration.

To test for the influence of phonetic differences, half of the participants heard a language synthesized using male Dutch diphones and half a language using male French diphones.

No stress condition: Monotone 120 Hz.

Stress conditions: A parabolic pitch rise-fall from 120 Hz to 170 Hz over the 1st or last syllable of each word (from Thiessen & Saffran, 2003).

Test items: 27 pairs of words and partwords (e.g., last syllable of one word and the first two syllables of another word). Participants were asked to indicate which member of each pair was a word of the language.

French vs. Dutch Experiment Results and Discussion

Participants performed the task very well – all mean scores were above chance (50%, many significantly so).

Data were analysed using planned contrasts:

Stress (initial + final) > No Stress

$M = 5.8\%$, $SE = 2.5\%$, 95%CI: 0.8%-10.8%.

For French listeners, final stress > initial stress, regardless of talker accent. Dutch listeners unexpectedly benefited from final stress, regardless of the talker, and only benefited from initial stress when the talker's accent was Dutch.

Significant Language Background x Stressed Syllable x Talker interaction: $M = 5.9\%$, $SE = 2.9\%$, 95%CI: 0.2%-11.7%.

Most of the Dutch participants had been exposed to French at school or on vacation, and many volunteered that the language "sounded French". Thus, Dutch listeners may have become sensitive to French word boundary cues. Only when the stress pattern was consistent with Dutch AND the speaker was Dutch did they benefit from initial stress.

Australian listeners, with much less knowledge of French, should benefit from initial stress only.

Australian Experiment Results

Stress (initial + final) > No Stress:

$M = 6.1\%$, $SE = 3.0\%$, 95%CI: 0.1%-12.1%.

Initial stress > final stress:

$M = 9.4\%$, $SE = 3.5\%$, 95%CI: 2.5%-16.3%.

No interactions.

Australians benefited from initial stress only, regardless of talker accent.

General Discussion

Monolingual French and Australian listeners learn words more successfully in an artificial language when prosodic word boundary cues match those of their native language.

Multilingual Dutch listeners appear to have expanded their repertoire of segmentation cues when learning French, so were able to vary their strategy to suit.

Therefore, for second-language (L2) learners:

Segmentation is easier when L1 and L2 word boundary characteristics are shared.

Initial insensitivity to L2 characteristics that are not present in the L1 can (sometimes) be overcome with L2 experience.

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