This research examined whether a consonant cluster must occur in a certain phonotactic position in a language in order to be perceived. We examined the consonant cluster /pt/ which occurs in English in word-final position (e.g., kept) but does not occur in word onset. We contrasted /pt/ with the syllable “pet” (e.g., trumped/trumpet; petunia). Native-English listeners were compared with native-Polish listeners because both the cluster /pt/ and the contrast segment “pet” occur in word onset in Polish (e.g., ptak (bird); Petronella).

Event-related potentials (ERP) were recorded while participants heard 800 pairs of nonsense words (natural stimuli). All nonsense words were potential real words in Polish and English with the exception of nonsense words that began with “pt”, an illegal phonotactic form in English (e.g., pteba-pteba; ptuza-petuza). Nonsense-words pairs beginning with /st/ or “set” were used as experimental controls (e.g., stina-setina steba-steba). The behavioral task, performed while ERP’s were recorded, required the participants to decide if the second word in the nonsense-word pair had two or three syllables. The same and different nonsense-word pairs were designed as a phonological priming task (ERP portion of the experiment). The results of the experiment indicated that native-English and native-Polish listeners determined if words beginning with /st/ or “set” had two or three syllables with close to perfect performance. The native-Polish group, but not the native-English group, identified the “pt” type nonsense words as having two or three syllables with above-chance levels of accuracy. Using a criteria of 80% correct on all conditions (four ‘pt’ type conditions) for each participant, the results of the nonparametric Fisher-Exact test revealed that it was highly unlikely that the language groups were from the same population with regard to this task (p=.0052 Fisher-Exact Test). Group averaged ERP results revealed a greater positivity for the native-Polish participants for “pt” different pairs (3 syllable targets) than for “pt” same pairs peaking at a latency of approximately 500 ms (posterior parietal sites). Evidence of an N400 response was observed in individual data. The greater positivity peaking around 500 ms for “st” different pairs (3 syllable targets) than for “st” same pairs was observed for both language groups.

In conclusion, it appears that a consonant cluster must occur in a particular phonotactic context in a language in order to be perceived. In conversational speech, the sequence “pt” occurs (e.g., “The volcano will erupt in a year” ptina) but never without a preceding vowel. The probability of hearing the /pt/ cluster in English without a preceding vowel is zero. The acoustic system was exposed during development to the features of the consonant cluster /pt/ that included those of a preceding vowel. These seemingly small acoustic changes that occur with context resulted in dramatic differences in perception. Because sound sequences similar to those presented in the experiment (e.g., /pt/ as in ptina) occur in English but are not perceived by native-English listeners, the view that there is no reality to the phoneme as an isolated unit in processing is supported. Rather, perception involves a blending of all acoustic features including those of the phoneme that change with prevocalic and postvocalic positions and patterns of stress. Direct electrical recordings within A1 of the primary cortex in monkey and human brains indicate that speech is processed by acoustic features (Steinschneider et al., 2005). Our findings highlight the importance of feature analysis in perceptual processing. Exposure during development to the acoustic features of phonemes and phoneme sequences that vary with the context and stress patterns within the syllable results in a processing system that is sensitive to the phonotactic structure of the native language.


