



Figure 3.17 Phonemes in American English [6],[32]. Orthographic symbols are given in parentheses to the right of the International Phonetic Alphabet symbols.

consonants are not normally allowed at the end of words. The ordering of the phonemes is also determined in part by the underlying articulatory features of the phones; for example, vibration of the vocal folds or a particular vocal tract shape can constrain or influence the following sound.

A phoneme is not strictly defined by the precise adjustment of articulators; for example, the tongue hump forming a 0.1-mm constriction with the palate, 3 cm along the oral tract, will likely correspond to the same phoneme when these specifications are changed by a few percent. The articulatory properties are influenced by adjacent phonemes, rate and emphasis in speaking, and the time-varying nature of the articulators. The variants of sounds, or phones, that convey the same phoneme are called the *allophones* of the phoneme [29]. Consider, for example, the words “butter,” “but,” and “to,” where the /t/ in each word is somewhat different with respect to articulation, being influenced by its position within the word. Therefore, although the allophones of a phoneme do have consistent articulatory features, the fine details of these features vary in different conditions. In this sense, then, the concept of a phoneme as a distinctive unit of a language is abstract.