

is shaped in such a way as to form side branches, different from all other oral tract formations thus far [33]. The presence of these side branches can introduce anti-resonances. With /l/ the tongue tip is pressed against the palate, and is shaped to form two openings, one on each side of the contact point with air passing on each side. For the liquid /r/, two different tongue formations are known to exist, one with a tongue tip raised at the palate as shown in Figure 3.28 and creating a space under it, and the other with the tongue tip lowered and the tongue hump bunched near the palate forming a side branch to the primary oral cavity [7],[33].¹² In addition, the liquids are typically characterized by an effective constriction of the pharynx, quite unusual for American English consonants; magnetic resonance image vocal tract profiles have shown such constrictions [7],[24]. The formant transitions differ for all four semi-vowels; nevertheless, these transitions are smooth except for the liquid /l/, whose spectral evolution is discontinuous because the tongue tip holds and releases its contact with the palate.

Affricates: This sound is a counterpart of diphthongs, consisting of consonant plosive-fricative combinations, rapidly transiting from plosives to fricatives. The articulation of affricates is similar to that of fricatives. The difference is that for affricates, the fricative is preceded by a complete constriction of the oral cavity, formed at the same place as for the plosive. An example is the /tS/ in the word “chew,” which is the plosive /t/ followed by the fricative /S/. The voiced counterpart to /tS/ is the affricate /J/ as in “just,” which is the voiced plosive /d/ followed by the voiced fricative /Z/.

Coarticulation — Although our vocal fold/vocal tract muscles are programmed to seek a target state or shape, often the target is never reached. Our speech anatomy cannot move to a desired position instantaneously and thus past positions influence the present. Furthermore, to make anatomical movement easy and graceful, the brain anticipates the future, and so the articulators at any time instant are influenced by where they have been and where they are going. *Coarticulation* refers to the influence of the articulation of one sound on the articulation of another sound in the same utterance and can occur on different temporal levels. In “local” coarticulation, articulation of a phoneme is influenced by its adjacent neighbors or by neighbors close in time. Consider,

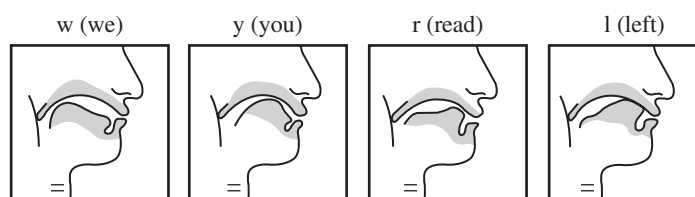


Figure 3.28 Configurations of glides and liquids. Horizontal lines denote voicing.

SOURCE: R.K. Potter, G.A. Kopp, and H.G. Kopp, *Visible Speech* [31]. ©1966, Dover Publications, Inc. Used by permission.

¹² It is interesting that these two very different vocal tract formations can result in similar acoustic characteristics [13]. We discuss this observation further in Section 3.6.2.