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How to Use This Guide

Speech-language pathologists (SLPs) frequently assess and provide intervention to “correct” the production of speech sounds. Most SLPs’ information regarding production of speech sounds is based on listening to speech and providing an impressionistic phonetic transcription. However, it is also important to know where the articulators are positioned during speech in order to provide clear feedback about accurate speech sound production. The purpose of *Seeing Speech: A Quick Guide to Speech Sounds* is to facilitate understanding of the similarities and differences between the articulation of consonants and vowels by providing 4 static images per sound. A static image is one distinctive representation that is frozen in time and captures the most significant aspects of the consonant or vowel being studied. Each half page contains 4 different static representations of a given speech sound: (1) photograph, (2) schematic drawing, (3) ultrasound, and (4) electropalatograph (EPG) frame. Combining data from the 4 images specifies the position of the lips, tongue, palate, velum, and larynx for each English consonant and vowel.

Seeing Speech: A Quick Guide to Speech Sounds is an indispensable resource for:

1. SLPs who work with adults and children to change their articulation of sounds, and
2. students of phonetics and speech-language pathology as they develop an understanding of the similarities and differences between sounds.

By flipping the book to compare speech sounds, SLPs, students and people with communication disorders can see the differences between one sound and another. For example, if a person is producing a [w] instead of the /ɪ/ sound, then the photograph demonstrates that the lips are

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rounded for /w/ and are unrounded for /ɪ/. The schematic drawing indicates that both sounds are voiced and have an open velopharynx, while the tongue position is different. The ultrasound image shows that for /w/, the tongue is arched similarly to the tongue shape for the other velar sounds, /k, g, ŋ/: the tongue tip is down (right of the image) and the back of the tongue is high and back in the mouth. In contrast, for /ɪ/, the tongue tip is raised toward the alveolar ridge. The bunched nature of /ɪ/ is shown with the back of the tongue placed forward in the oral cavity. For the EPG image of /w/, there is limited tongue/palate contact; whereas there is slightly more contact for /ɪ/ along the posterior lateral margins of the palate.

**INTERPRETING STATIC IMAGES OF
CONSONANTS AND VOWELS**

Interpretation of the photograph, schematic drawing, ultrasound, and electropalatographic (EPG) images will be described in turn.

Photograph

The photographs emphasize the front, or outside of the mouth. They provide detail regarding the placement of the lips, teeth, jaw, and, in some cases, the tongue at a single moment during the production of a consonant or vowel.

Schematic Line Drawing

The schematic line drawing emphasizes the position of the tongue during the production of a particular consonant or vowel. The voicing of a phoneme is indicated by the use of a plus or minus sign at the approximate point of the larynx. In most images, the velopharyngeal port is closed, indicating oral airflow. However, in the drawings for /m, n, ŋ/ the velopharyngeal port is open.

The schematic diagrams were created by superimposing ultrasound images of the tongue onto a diagram of the head. It is important to note that the schematic diagrams represent only the midline of the head (mid-sagittal plane). Consequently, detail regarding the lateral margins of tongue movement is not included. This can lead to the misconception that the sides of the tongue are in similar configuration to the midline. This is particularly relevant in the production of alveolar sounds. For example, during the production of the following alveolar sounds, the midpoint of the tongue is raised to the alveolar ridge: /t, d, n, s, z, l/. However, comparison between the schematic line drawings and the electropalatography (EPG) images reveals that it is only the /l/ sound that has a consistent tongue placement across the midline and lateral margins of the palate. For the other six sounds, the sides of the tongue are raised to rest near the teeth to provide lateral bracing.

Ultrasound

Ultrasound enables us to view the surface of the tongue during speech. To create an ultrasound image, a transducer is held below the chin and a wedge-shaped scan of sound waves emanates from the transducer. The sound waves travel through the body of the tongue until they reach the upper tongue surface. The white line on the ultrasound image is a reflection of the air above the surface of the tongue, or the tongue on the palatal surface. The thickness of this line is not relevant. Typically, approximately 1 cm of the tongue tip is not visible in the production of alveolar sounds due to the acoustic shadow of the jaw. Similarly, the tongue root may be obscured due to the acoustic shadow of the hyoid bone.

Ultrasound images of the midsagittal plane of the tongue were taken during production of speech sounds and words. Ultrasound images traditionally are taken with the head facing the right. Figure 1 shows the tongue at rest, which can be used as a comparison with the other ultrasound images in *Seeing Speech*. The bright white line is the surface of the tongue. The air shadow can be seen above this bright white line and the muscles and fatty tissue of the tongue can be seen below the white line. In each image an arrow cursor has been included at approximately the level of the nose (top right quadrant), so that comparisons can be made.

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Figure 1. Ultrasound image of the tongue at rest. The tongue is below the bright white line and the tongue tip is on the right.

As for the schematic line drawings, it is also important to note that ultrasound images only represent the midsagittal plane of the tongue. It is essential to compare the ultrasound images with the EPG images to determine the location and movement of the lateral margins of the tongue. Again, this is particularly important for the production of the alveolar sounds: /t, d, n, s, z, l/.

Electropalatography: Single Frames

The electropalatograph (EPG) records tongue contact with the palate during speech production, providing a printout of activated electrodes every 10 msec. The EPG has an artificial palate (shown in Figure 2, center image) that is individually molded to fit the roof of the mouth.

Row	EPG frame of the maximum point of contact for /s/	Region of palate	Hypothesized area of tongue	EPG palate	Dental cast with junction between hard and soft palate drawn
1		Alveolar (2 rows)	Anterior (tip)		
2		Palatal (3 rows)	Blade		
3		Velar (3 rows)	Posterior (body)		
4					
5					
6					
7					
8					

Figure 2. An example of an EPG frame for the production of /s/ juxtaposed with an EPG palate and dental cast. The black squares represent the contacted electrodes. The zoning scheme is adapted from Gibbon (1999). The EPG frame, EPG palate, and dental cast are from the same speaker who produced the EPG images for the *Seeing Speech*.

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The Reading EPG used to create the images in this book has 62 electrodes that record tongue contact with the surface of the palate. Figure 2 shows one EPG frame (left image). The black squares represent the activated electrodes where tongue to palate contact has occurred. The white squares indicate that no contact has occurred. The areas of the palate can be separated into three zones: alveolar, palatal, and velar (Hardcastle & Gibbon, 1997). The top of the EPG frame corresponds with the alveolar region immediately behind the front teeth. The final row of squares corresponds with the juncture between the hard and soft palates. The maximum point of contact is often selected for analyzing the place of articulation for individual speech sounds as it provides a point of comparison (Hardcastle & Gibbon, 1997). This is selected by identifying the frame that has the highest number of contacted electrodes. An example of the maximum contact frame for /s/ is shown in Figure 2 (left). Notice the narrow groove, or absence of electrode contact at the top of the image. This is where the hissing air escapes to produce the fricative quality of the /s/ sound.

MORE INFORMATION ABOUT IMAGES OF SPEECH SOUNDS

Seeing Speech: A Quick Guide to Speech Sounds has a companion book *Speech Sounds: A Pictorial Guide to Typical and Atypical Speech* (McLeod & Singh, 2009), which includes both static and dynamic images of the consonants and vowels in English with clear explanations for each image. Each chapter represents a different English consonant or vowel. Additionally, numerous images illustrating typical and atypical speech have been included from an extensive cross-section of published literature. This unique encyclopedic book enables ease of comparison of speech sound production across:

- ◆ the lifespan (children and adults)
- ◆ dialects of English (United States, Canadian, English, Scottish, Australian,)

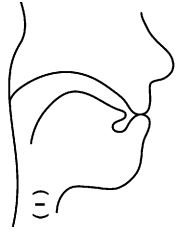
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FRONT VIEW



SIDE VIEW

Voiceless bilabial stop



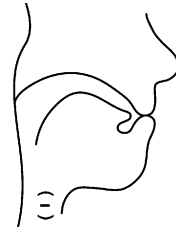
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FRONT VIEW



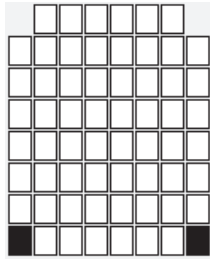
SIDE VIEW

Voiceless bilabial stop



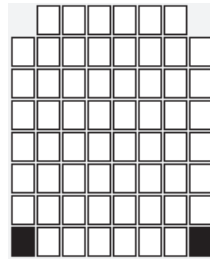
PALATE VIEW

Very limited contact along velar margins



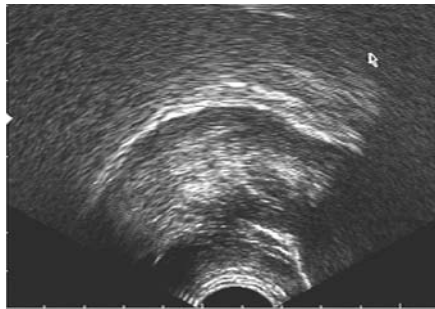
PALATE VIEW

Very limited contact along velar margins



TONGUE VIEW

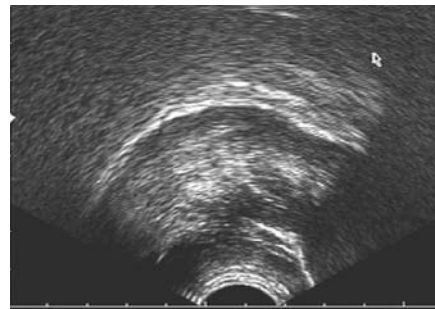
Tongue body slightly raised



Tongue tip

TONGUE VIEW

Tongue body slightly raised



Tongue tip

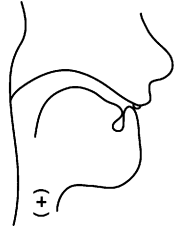
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FRONT VIEW



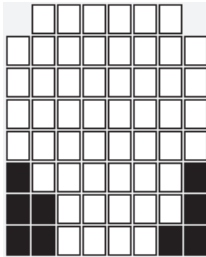
SIDE VIEW

Voiced bilabial fricative



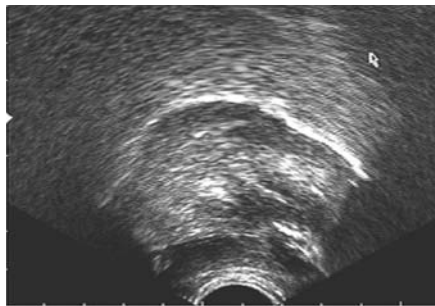
PALATE VIEW

Limited contact along velar margins



TONGUE VIEW

Tongue tip down; tongue body slightly raised



Tongue tip

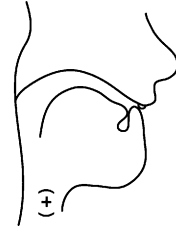
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FRONT VIEW



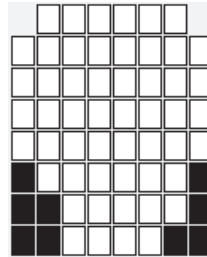
SIDE VIEW

Voiced bilabial fricative



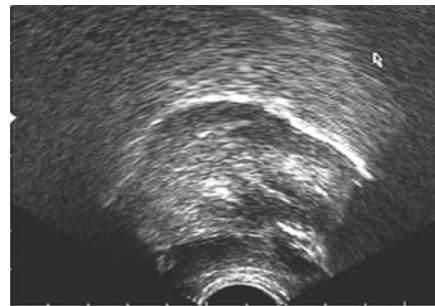
PALATE VIEW

Limited contact along velar margins



TONGUE VIEW

Tongue tip down; tongue body slightly raised



Tongue tip

/æ/

FRONT VIEW



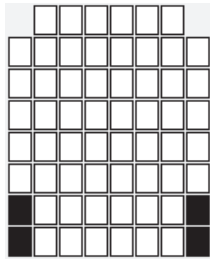
SIDE VIEW

Low, front, neutral, and unrounded vowel



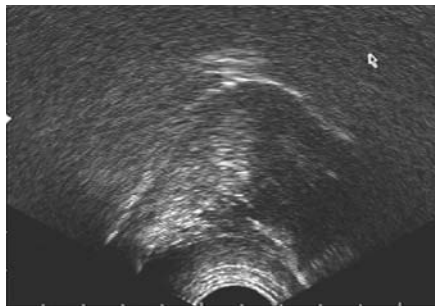
PALATE VIEW

Limited contact along velar margins



TONGUE VIEW

Tongue body slightly raised



Tongue tip

/æ/

FRONT VIEW



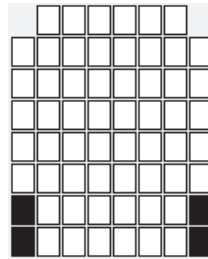
SIDE VIEW

Low, front, neutral, and unrounded vowel



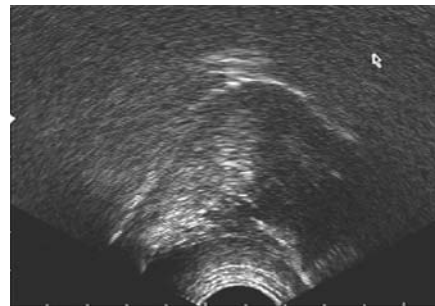
PALATE VIEW

Limited contact along velar margins



TONGUE VIEW

Tongue body slightly raised



Tongue tip