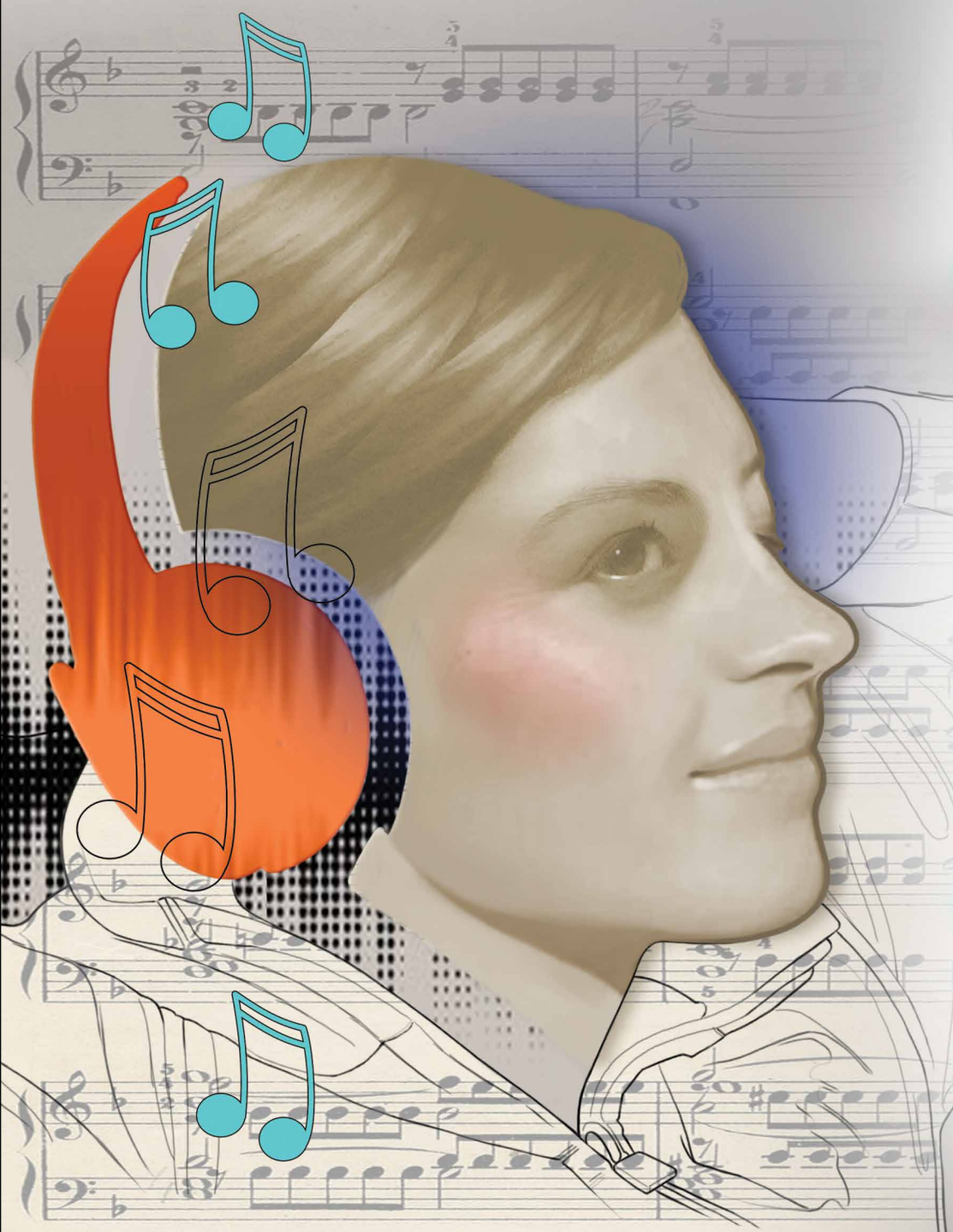
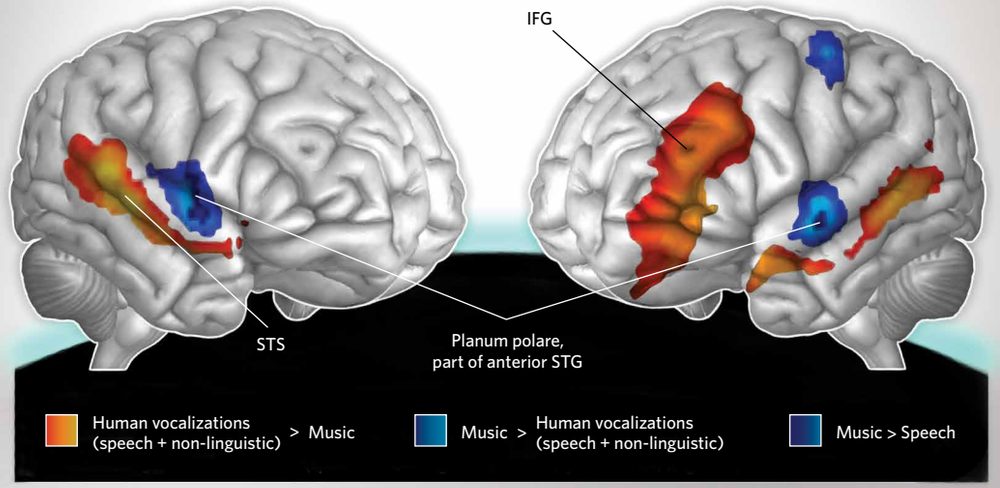
MAPPING MUSICALITY

Huge areas of the brain respond to any sort of auditory stimulus, making it difficult for scientists to nail down regions that are important specifically for music processing. Functional magnetic resonance imaging (fMRI) studies have taken diverse approaches to pinpointing areas involved in musical perception, providing "musical" stimuli ranging from human singing to synthesized piano melodies and other computer-generated sounds, and yielding equally varied results. Despite these hurdles, research is beginning to offer some clues about the regions of the brain involved in musical perception.



MUSIC SPECIFICITY

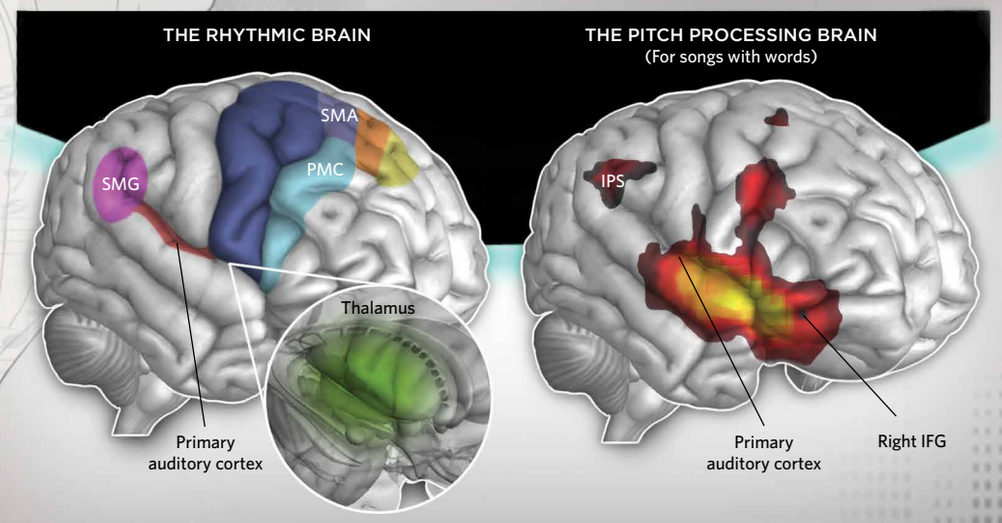
Music activates diverse areas of the brain, from the primary auditory cortex to the amygdala. But the degree to which certain areas are specifically geared to processing music, as opposed to other sounds, is unclear. By comparing activation patterns in the brain while people listened to nonmusical human vocalizations, such as speech or laughter, or to instrumental music, researchers found that certain regions responded more strongly to one type of auditory stimulus than the other. For example, parts of the superior temporal gyrus (STG), the superior temporal sulcus (STS), and the inferior frontal gyrus (IFG) showed stronger responses to vocalizations than to music (orange), while other areas such as the planum polare (part of the anterior STG) showed stronger responses to music than to vocalizations (blue).



BEAT AND PITCH

Some fMRI studies have focused on identifying the brain circuitry underlying specific components of auditory perception. For example, the primary auditory cortex (located in the STG) and the thalamus are thought to play prominent roles in beat perception for both music and speech, and trained musicians may recruit extra language-processing areas such as the supramarginal gyrus (SMG) when listening to complex rhythms. In addition, several regions considered to be part of the motor system have been associated with beat perception, including the supplementary motor area (SMA) and the premotor cortex (PMC), suggesting an important link between perceiving a rhythm and synchronizing movement to it.

Studies of pitch processing, meanwhile, have repeatedly highlighted a role for the auditory cortex, although evidence for the overlap between speech and music in this and other areas is mixed. Some regions, however, including the intraparietal sulcus (IPS, located on the parietal lobe), appear to be activated more by pitch in sung words than by pitch in spoken words. Additional observations revealed differential lateralized activity for song and speech: the left inferior frontal gyrus (IFG), for example, dominates in pitch processing for speech, while the right IFG takes over for song.



GLOSSARY

MUSICALITY
A naturally developing set of biological traits that amount to a capacity to perceive and/or produce music

PITCH PROCESSING
Detection of how high or low a musical note is, either without any reference (absolute pitch) or in relation to the notes surrounding it (relative pitch)

BEAT PERCEPTION
Detection of a regular pulse in music—a prerequisite for synchronizing movements to produce rhythmic drumming or melodies, for example, or to coordinate dance to music

TIMBRE
The sound quality or "color" of a piece of music, achieved by the combination of voices or instruments producing the sounds

TONALITY
A feature contributing to the character of a piece of music, based on the organization of musical tones into scales or keys around one central, tonic note

CONSONANCE
The property of an interval or chord in which musical notes sound in harmony with each other due to their relative frequencies. Consonant intervals are typically considered pleasant, and include perfect fifths, perfect octaves, and major thirds.

AMUSIA
The condition of being unable to recognize or reproduce musical notes. Commonly known as tone-deafness, amusia can be present at birth (congenital) or acquired later in life.

BASED ON *CORTEX*, 59:126-37, 2014. (TOP); *CEREB CORTEX*, 24:836-43, 2014 AND *PHILOS TRANS R SOC LOND B BIOL SCI*, 370:20140093, 2015 (BOTTOM LEFT); *FRONT PSYCHOL*, 3:76, 2012 (BOTTOM RIGHT).