Chapter 15 Neurolinguistics
John W. Schwieter

"Delving Deeper"

The effect of right- and left-handedness on language lateralization

We mentioned in the chapter the most individuals show a tendency to have language lateralized in the left hemisphere. This is the case for right-handed individuals 94-96% of the time (Szaflarski et al., 2002). But what about left-handed and ambidextrous (i.e., write with both hands) people? In a study by Szaflarski et al., the researchers used fMRI technology on 50 non-right-handed individuals who performed several language activation and control tasks. Imaging of their brains showed activation primarily in the left hemisphere (like right-handed individuals) for 78% of the participants. There was symmetric activation found for 14% of the participants and primarily in the right hemisphere for 8%.

The 22% of the participants who did not show the typical left hemisphere lateralization is strikingly distinct from the 4-6% of right-handed individuals who do not. This important fMRI study found a significant relationship between language laterality and handedness. Szaflarski et al. (2002) suggest that their findings may help to indicate a common genetic factor which explains how handedness and language lateralization are inherited.

Hemodynamic neuroimaging

In addition to PET and fMRI that we looked at in the chapter, two other brain imaging technologies are growing in frequency in neurolinguistic research. These are diffusion tensor imaging (DTI) and functional near-infrared spectroscopy (fNIRS).

DTI is a type of MRI which uses senses and tracks water molecules in fiber tracks in the brain. It can be used to study the nature and pathway of nerve fiber bundles. This method is becoming very popular in neurolinguistic studies that explore whether there are specialized language centres in the brain (i.e., whether language is modular) or whether language processes are distributed across several connected brain areas. One benefit of the DTI is that it can show the brain area that was damaged from a stroke, for instance, usually within 20 minutes of the incident. It would take up to 6 hours for an fMRI to show a damaged brain area and up to 3 or 4 days for a CT scan. This because a DTI is able to not just track blood flow, but the water molecules and their trajectories in that blood flow.

Another method that is similar to fMRI in that it measures the dynamics of blood flow in the brain is called **fNIRS**. Although the fMRI and fNIRS measure the same thing, the physics of *how* they measure it are distinct: the fMRI uses magnetic resonance signals and the fNIR relies on the absorption of near-infrared light. Some advantages of fNIRS is that it is much less costly and more portable than fMRI. fNIRS uses a skull map whereas fMRI requires a large machine in which a subject must lie. However, a disadvantage of fNIRS is that its spatial resolution is not as high as that of fMRI. Furthermore, it cannot penetrate more than about 10 mm from the surface of the cortex.

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Reference

Szaflarski, J., Binder, J., Possing, E., McKiernan, K., Ward, B., & Hammeke, T. (2002). Language lateralization in left-handed and ambidextrous people: fMRI data. *Neurology, 59*(2), 238-244.

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