Lecture 8 THE PSYCHOLOGY OF SECOND LANGUAGE ACQUISITION

The plan:

Languages and the brain
Positron Emission Tomography
Mapping the brain surface

Notions that particular locations in the brain may be specialized for language functions date back at least into the nineteenth century. Paul Pierre Broca (1861, 1865) observed that an area in the left frontal lobe (Broca's area) appeared to be responsible for the ability to speak and noted that an injury to the left side of the brain was much more likely to result in language loss than was an injury to the right side. Wernicke (1874) further identified a nearby area which is adjacent to the part of the cortex that processes audio input (Wernicke's area) as also being central to language processing. Some exceptions have been found, but for the vast majority of individuals, language is represented primarily in the left half (or hemisphere) of the brain within an area (including both Broca's area and Wernicke's area) around the Sylvian fissure (a cleavage that separates lobes in the brain). Subsequent research has shown that many more areas language activity is not localized, but core linguistic processes are typically housed in the left hemisphere.

Such specialization of the two halves of the brain is known as lateralization, and is present to some extent even in infancy (e.g. Mills, CoffeyCorina, and Neville 1993). There is increased specialization as the brain matures and has less plasticity: i.e. one area of the brain becomes less able to assume the functions of another in the event it is damaged. Lenneberg (1967) proposed that children had only a limited number of years during which they could acquire their L1 flawlessly if they suffered brain damage to the language areas; brain plasticity in childhood would allow other areas of the brain to take over the language functions of the damaged areas, but beyond a certain age, normal language would not be possible. This is the Critical Period Hypothesis, can be discussed below in relation to the influence of age on SLA.

In discussing hemispheric specialization, Obler and Gjerlow emphasize that, "while localizing language phenomena in the brain is the eventual goal of neurolinguistics, we no longer expect that there are language areas that are entirely 'responsible' for language, or even 'dominant' for language, to be contrasted with areas that have nothing to do with it" (1999:11–12). Hemispheric specialization for language is the same regardless of whether the language is spoken or not; core linguistic functions for sign languages used in deaf communities are also located in the left hemisphere. The visuospatial information listed for the right hemisphere in Table 4.1 refers to movement which may be meaningful but is nonlinguistic in nature. When movement incorporates linguistic units of phonology, morphology, and syntax (as in sign language), it is left-hemisphere based (Emmorey 2002). The typical distribution of primary functions is probably due to the left hemisphere's being computationally more powerful than the right and therefore better suited for processing the highly complex elements of language. Interest in how the brain might be organized for multiple languages also dates back to the nineteenth century (e.g. Freud 1891).

The initial questions arose from observing differing patterns for the interruption and recovery of languages following brain damage in multilinguals. Most individuals lose or recover multiple languages equally (Paradis 1987), but some recover one before the other, and some never recover use of one (either L1 or L2). These findings suggest that two or more languages may be represented in somewhat different locations in the brain and/or have different networks of activation. This possibility has stimulated observation and research on the topic for the past century, although research procedures have changed radically with changing technology. Methods for gathering data have included the following: • Correlations of location of brain damage with patterns of loss/ recovery in cases where languages are affected differentially. • Presentation of stimuli from different languages to the right versus the left visual or auditory fields to investigate which side of the brain is most involved in processing each language. What is presented to the right fields will be processed faster and more accurately by the left hemisphere and vice versa.

Mapping the brain surface during surgery by using electrical stimulation at precise points and recording which areas are involved in which aspects of speech, and in which language. (This mapping procedure is often used prior to or even during removal of brain tissue because of a tumor or other abnormality, allowing the neurosurgeon to avoid disrupting language functions as much as possible.) • Positron Emission Tomography (PET-scans), functional Magnetic Resonance Imaging (fMRI), and other non-invasive imaging techniques that allow direct observation of areas of the brain that are activated by different language stimuli and tasks. In spite of many years of research, some questions remain unanswered or answers remain controversial. In part this is because study has generally involved limited numbers of subjects and there is considerable individual variation in how the brain is "wired"; in part it is because research efforts have not used the same procedures for data collection and analysis and therefore do not yield entirely comparable results. Still, there are a number of findings which shed increasing light on the representation and organization of multiple languages in the brain. Specific questions which have been explored are listed below, along with a brief summary of results from some of the research conducted on them.

There is no single answer to this question, both because there appears to be considerable individual variation among speakers, and because there are very complex factors which must be taken into account. It seems reasonable to conclude, however, that multiple language systems are neither completely separate nor completely fused. Ervin and Osgood (1954 ; following Weinreich 1953) suggested a three-way possibility for how languages relate in an individual's mind, which are called coordinate, compound , and subordinate bilingualism. Coordinate refers to parallel linguistic systems, independent of one another; compound to a fused or unified system; and subordinate to one linguistic system accessed through another. Ervin and Osgood claim that these different relationships result in part because of different contexts for language learning. An extreme case of coordinate bilingualism would be the rare individual who has learned two or more languages in different contexts and is not able (even with conscious effort) to translate between them.

More common would be compound bilingualism, believed by many to characterize simultaneous bilingualism in early childhood (before the age of three years), and subordinate bilingualism, believed to result from learning L2 through the medium of L1 (as in grammar-translation approaches to foreign language instruction). There is evidence that suggests the relationship may depend on L2 proficiency, changing from compound or subordinate to coordinate at higher knowledge and skill levels (Kroll and Stewart 1994). Other researchers stress the interdependence of languages, although separation can be maintained for many purposes. Obler and Gjerlow conclude that multiple linguistic systems "are only as independent as necessary, and reliance on a single system is the rule whenever possible" (1999 :140). Recent studies have focused on evidence for two distinct memory systems, which may involve different representations of L1 and L2 grammars (see e.g. review in Green 2008). 2. How are multiple language structures organized in relation to one another in the brain? Are both languages stored in the same areas? Again, there is considerable variation among speakers. For at least some multilinguals, it appears that L1 and L2 are stored in somewhat different

INTRODUCING SECOND LANGUAGE ACQUISITION areas of the brain, but both are predominantly in (probably overlapping) areas of the left hemisphere. However, the right hemisphere might be more involved in L2 than in L1.

Researchers have stimulated certain segments of the brain during surgery (Ojemann and Whitaker 1978) and found that disturbing some points in the brain blocks people from being able to name things in both languages, while disturbing other points does not have this effect. The area common to both L1 and L2 storage is near the Sylvian fissure in the left hemisphere (already established as the primary language area for monolinguals, including Broca's and Wernike's areas), but only L1 or L2 (more likely L2) is disrupted by stimulation of points further away from the Sylvian fissure. Using PET-scan imaging on one Spanish–English subject in repetition tasks, Fedio et al. (1992) also found more diffuse brain activation for L2 than for L1, and different areas involved, which the authors interpreted as indicating that greater memorization of words and phrases is involved in L2 (as opposed to direct processing of words for meaning in L1).

3. Does the organization of the brain for L2 in relation to L1 differ with age of acquisition, how it is learned, or level of proficiency? The answer is probably "yes" to all three, with the strongest body of evidence showing that age of acquisition influences brain organization for many second language learners (see Watterndorf and Festman 2008 for a comprehensive review). After reviewing research on lateralization in bilinguals, Vaid (1983) concludes that individuals who acquire L2 later in life show more righthemisphere involvement. Supporting this conclusion, Wuillemin and

Richards (1994) report more right-hemisphere involvement for individuals who acquire L2 between ages nine and twelve than for those who acquire L2 before age four. Cook suggests that how people learn languages might be a factor: “The variation in right hemisphere involvement may be due to the lack of a single route to L2 knowledge: second languages may be learnt by many means rather than the single means found in L1 acquisition and, consequently, may have a greater apparent hemispheric spread” (1992:572).

Hull and Vaid (2007) also report on the significance of amount and duration of L1 and L2 exposure. Because they have more experience with interpreting and producing two languages, perhaps “early bilinguals intensify or accelerate the automatization of language processes” (Wattendorf and Festman 2008 :16). 4. Do two or more languages show the same sort of loss or disruption after brain damage? When there is differential impairment or recovery, which language recovers first? As noted in the first part of this section, brain damage results in the same or very similar patterns of loss and recovery for both/all of most multilingual persons’ languages, but many exceptions have been reported. One The psychology of Second Language Acquisitio early hypothesis was that in cases of such brain damage, the last-learned language would be the first lost, the next-to-the-last learned the second to be lost, and so forth, with L1 the last to remain; recovery was speculated to be L1 first.

Psychology provides us with three major frameworks for the focus on learning processes: Information Processing (IP), Connectionism, and Complexity Theory. IP has had more influence on the study of SLA than any other psychological perspective, following an approach developed by John Anderson (e.g. 1976, 1983). All three make the claim that learning language is essentially like learning other domains of knowledge: that whether people are learning mathematics, or learning to drive a car, or learning Japanese, they are not engaging in any essentially different kind of mental activity. Learning is learning. We take a general look at the information- processing framework and then discuss three approaches based on it, the Multidimensional Model, Processability, and the Competition Model, respectively. The Connectionism framework also claims that “learning is learning,” but considers learning processes as a matter of increasing strength of associations rather than as the abstraction of rules or principles. Complexity Theory focuses on processes and states of change in a wide variety of domains. As it has been applied to language development, it differs from other psychological approaches in the importance it gives to (1) social and contextual as well as cognitive factors and (2) the role of variability.

This in fact does not appear to occur at a level greater than chance, at least with respect to order of recovery. Obler and Gjerlow (1999) conclude rather that a significant factor in initial recovery is which language was most used in the years prior to the incident which caused the damage, whether this is L1 or L2. Research on this question also shows that not only can different languages be affected differentially by brain damage, but different abilities in the same language may be differentially impaired: e.g. syntax versus vocabulary, production versus comprehension, or oral versus written modality. These observations have possible implications for claims that different elements of language are located in separate parts of the brain. We may conclude that what is being added in the brain when a second language is acquired is not very different from, nor usually entirely separate from, what is already there for the first. But there are intriguing differences: some differences may be due to level of L2 proficiency, some to circumstances of L2 learning, and some to the fact that our brains are not "wired" in exactly the same way. Research on this focus is expanding rapidly with the help of brain-imaging technology, and it promises also to contribute more neurological answers to questions of how second languages are learned and why some people are more successful than others.

Questions for discussion

1. How independent are the languages of multilingual speakers?
2. How are multiple language structures organized in relation to one another in the brain? Are both languages stored in the same areas?
3. Does the organization of the brain for L2 in relation to L1 differ with age of acquisition, how it is learned, or level of proficiency?
4. Do two or more languages show the same sort of loss or disruption after brain damage? When there is differential impairment or recovery, which language recovers first?