Chapter 7
The Miracle Year:
From Basic Structure to
Social Communication

Heather Bortfeld
University of Connecticut, USA & Haskins Laboratories, USA

Kathleen Shaw
University of Connecticut, USA

Nicole Depowski
University of Connecticut, USA

ABSTRACT

In recent years, a functional perspective on infant communication has emerged whereby infants’ production of vocal sounds is understood not only in terms of the acoustic properties of those sounds, but also in terms of the sounds that regulate and are regulated by social interactions with those hearing them. Here, the authors synthesize findings across several disciplines to characterize this holistic view of infant language learning. The goal is to interpret classic and more recent behavioral findings (e.g., on infants’ preferences) in light of data on pre- and postnatal neurophysiological responses to the environment (e.g., fetal heart rate, cortical blood flow). Language learning is a complex process that takes place at multiple levels across multiple systems; this review is an attempt to embrace this complexity and provide an integrated account of how these systems interact to support language learning.

INTRODUCTION

We know that a great deal of language development takes place in the first year of life. During this initial period, infants are immersed in the ambient language(s), which—together with a dynamic period of neural development—support rapid and robust language learning. A key factor in this process is the infant’s own active elicitation of responses from his or her caregivers. This communicative give-and-take creates an environment rich in linguistic structure, providing input that is fundamental for language development to take place. In this chapter, we will review data that highlight the dynamic nature of caregiver-child interaction and how this impacts multiple systems in support of language learning. Specifically, we will discuss the degree to which children enter
the world neurally primed to learn the ambient language(s), the learnable structures that are inherent in languages, and how communicative interaction between caregivers and infants potentiates and supports their learning of these structures.

**LEARNING ABOUT SOUND STRUCTURE IN UTERO**

Strict interpretations of language development as completely experience driven or completely innately guided have softened in recent years, concomitant with accumulating evidence that changes in the environment have substantial effects on language outcome. Indeed, there is evidence that environmental tuning is at work in utero, thus demonstrating that, by the time an infant is born, biology and environment have already combined to set the process of language learning in motion.

Research on prenatal infants, while difficult to conduct, has been important to our emerging understanding of how exposure to sound in the womb gives babies a head start with language. The womb acts as a low-pass filter for sounds in the mother’s environment (Gerhardt, et al., 1990). This includes the voices of those around her and her own. Furthermore, where others’ voices vary in intensity depending on where they are relative to the mother, the mother’s own voice is present for the developing fetus at a relatively constant volume and with more clarity than other voices, given the internal nature of the source (e.g., mother’s vocal folds, articulators). This means that, in addition to the external voice, internal bone and membrane conduction supplements the signal, providing infants with a relatively robust and consistent source of speech input. How this signal interacts with the maturation of the infant’s auditory system is important to informing our understanding of what infants have already learned about language when they enter the world.

Using changes in the fetal heart rate as their dependent measure, Lecanuet et al. (1995) obtained some of the first physiological data to suggest that fetal hearing occurs before 28 gestational weeks. In fact, the fetus appears to respond to sound at 22 gestational weeks (Hepper & Shahidullah, 1994) and habituates to repeated sounds around 32 gestational weeks (Morokuma, et al., 2004). Moreover, as infants near term, their sensitivity to more complex auditory stimuli improves, allowing them to perceive variations in music (Kisilevsky, et al., 2004) and to differentiate between familiar and novel rhymes (DeCasper, et al., 1994). Thus, the concept of “experience,” rather than strictly referring to information available to the infant postnatally, implies a currently unknown threshold in prenatal auditory processing as well. Needless to say, this has not simplified theoretical debates about the degree to which nature and nurture come into play in early language development; it has only served to push the focal age for this debate earlier. However, these data represent an important advance in our understanding of the toolkit with which infants enter the world.

With the understanding that birth is not the initial point at which infants are exposed to environmental sounds, behavioral researchers have capitalized on measures of infant attention to establish the degree to which prenatal experiences underlie postnatal perceptual biases. This work has made it clear that fetal exposure to sound instills infants with a variety of sensitivities available upon arrival in the postnatal world. For example, newborns can discriminate speech from non-speech when played forward, but not backwards (Ramus, et al., 2000). In terms of language specific characteristics, neonates prefer their native language over another, unfamiliar language (Moon, Panneton-Cooper, & Fifer, 1993), can distinguish between stress patterns of different multisyllabic words (Moon, et al., 1993), and can categorically discriminate lexical versus grammatical words (Shi, Werker, & Morgan, 1999). Finally, 3-day-olds are sensitive to word boundaries (Christophe, et al., 1994), can distinguish between two rhythmically dissimilar languages (Mehler, et al., 1988; Nazzi, Bertoncini,
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