Editorial

Predicting the future: ERP markers of language risk in infancy

Many children with Specific Language Impairment (SLI) have been shown to have poor auditory processing skills for both speech and non-speech sounds (Tallal et al., 1993). However, there has been considerable disagreement about the etiology of SLI, as general auditory processing deficits are not always found in children with this diagnosis (Bishop et al., 1999; Schwartz, 2009). Nevertheless, research continues to highlight difficulties of auditory perception (e.g., Bavin et al., 2010). The causal factors contributing to SLI remain elusive for several reasons. One speculation is that the source of these deficits begins early in development, and that by the time SLI is diagnosed (age 3 years or older), the earlier manifestations are less apparent. Thus, investigations during the first few years of life are crucial for resolving questions about cause. However, the goal of obtaining sensitive or specific measures in infants and toddlers that have predictive value for later speech and language performance presents several challenges. First, only a narrow range of behavioral methods can be used with infants and toddlers (Werker and Curtin, 2005). Second, there are limitations in the information that can be extracted from measures appropriate for use with pre-verbal children. If the goal is to determine, for example, whether an infant can discriminate two contrasting stimuli using a head-turn paradigm to show preference for one stimulus over another, what would be the interpretation in the case that a child does not show preference? It is not clear by the absence of a response preference whether the infant is incapable of making the discrimination or simply “chooses” not to respond. In general, the number of behavioral trials necessary to assess an individual infant’s discrimination abilities with sufficient confidence is more than can be presented in a session, given an infant’s attentional limitations. A more common approach is to apply these methods at the group level; at least this has been the standard for studies investigating speech and language development.

Another approach to studying speech and language skills in pre-verbal children is to use neurophysiological techniques. Neurophysiology is a powerful complementary method for studying precursors to speech and language in infant and toddler populations. Event-related brain potentials (ERPs) are the most commonly used neurophysiological technique in the examination of auditory and speech processing (e.g., Näätänen et al., 2007). ERPs can provide important indices of stimulus processing, and most crucially, can provide an index of the timing of these processes, from input to behavioral output. Another key feature of using ERPs is that information about stimulus processing can be obtained even in the absence of behavioral indications.

Despite the importance of this technique for studying language-related processes, not much is known about the developmental features of auditory ERP components in children. Only a fraction of ERP studies have focused on maturational issues (e.g., Ponton et al., 2002; Shafer et al., 2000; Morr et al., 2002; Kushnirenko et al., 2002; Sussman et al., 2008). These few studies indicate that ERPs change dramatically during the first few years. The dramatic differences between infant and adult ERPs have led to considerable confusion in the literature regarding the functional significance of infant ERP components. It is vitally important to relate ERP components found during the first year of life to the more mature ERP components by tracing their maturational trajectory. Very few studies follow the same children longitudinally, even though such a design adds additional predictive power to reveal relationships between early ERP components and later measures.

The Choudhury and Benasich study in this issue is one of the few longitudinal studies of early auditory development using ERPs, and arguably the most extensive set of developmental auditory ERP data to date (Choudhury and Benasich, 2010). Their study examined auditory ERPs beginning at 6-months of age and sampled at 9, 12, 16, 24, 36 and 48 months of age and included a group of children at risk for SLI. Language measures obtained at 36 and 48 months of age allowed examination of how ERP indices of auditory processing at early ages correlated with language abilities demonstrated at later ages. This study confirms some findings from earlier investigations, such as shorter ERP peak latencies with increasing age (c.f. Morr et al., 2002; Ponton et al., 2002; Sussman et al., 2008). It also provides additional evidence as to the nature of infant mismatch responses (MMRs), where there has been inconsistency. Many studies have indicated that children over the age of 48 months exhibit an adult-like mismatch negativity (MMN) component to a wide range of auditory contrasts. Yet, in infants, many studies have observed a large fronto-central positive mismatch response (pMMR), rather than the negative-going MMN response found in later years (cf. Dehaene-Lambertz and Dehaene, 1994; Cheour et al., 1998). In the Choudhury and Benasich study, the pMMR was elicited in infants to a change in pitch (from 100 to 300 Hz) for two ISI manipulations (70 ms versus 300 ms), which peaked approximately 250 ms after the pitch change. The longitudinal nature of this study leaves no doubt that pMMR is the dominant response in infants and children up to the age of four years (but, c.f. He et al., 2007). However, to fully interpret these findings, a greater understanding of infant ERP components is required. Although the Choudhury and Benasich study represents a compre-
hensive start, considerably more information can be obtained from the ERP data by employing additional analytic tools that make use of the data from all electrode sites, such as global field power, current source density maps, and spatial correlations (e.g., Sussman et al. 2008; Shafer et al., 2010).

In sum, the Choudhury and Benasich study is an impressive investigation of child auditory development, and we look forward to further reports on these data.

References


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