Studies exploring fundamental issues in child language acquisition now number in the thousands, and the majority of these focus on aspects of linguistic competence that develop over the first three years of life (see Clark, 2003). However, children learning more than one language are poorly represented in this literature. Although most people in the world grow up in multilingual environments (Grosjean, 1982), only about 2% of basic research on language development includes children learning two languages (Bhatia & Ritchie, 1999). And given the strong applied emphasis in this area, the focus has been primarily on school-aged children, with little attention to bilingual learning in the early years. Only recently have researchers interested in the early stages of learning begun to explore speech processing by infants growing up with two languages, bringing new perspectives and experimental paradigms to the study of bilingual development. The goal in this commentary is first to contrast three major traditions in basic research on early language development along two key dimensions – how they characterize and measure language competence at different ages in their studies, and the extent to which each is concerned with features of the early language environment that might influence the child’s emerging linguistic abilities. I then focus on recent investigations of speech perception by infants hearing two languages, outlining some of the challenges we face in extending this research to infants in multilingual environments. Since a number of recent findings show that infants hearing two languages perform differently in speech perception experiments than do infants hearing only one (see Werker, Weikum and
Yoshida, Chapter 1 this volume; Vihman, Lum, Thierry, Nakai and Keren-Portnoy, Chapter 3 this volume), it is essential to understand the strengths and limitations of these experimental paradigms in order to make sense of the results. In particular, studies using speech perception paradigms with infants define language competence very narrowly and pay little attention to details of the early language environment that might influence infants’ performance in such tasks, factors which make it difficult to interpret group differences between children growing up in monolingual and bilingual environments.

**Different Measures of Competence and Linguistic Input in Research on Early Language Development by Monolingual Children**

The three most influential paradigms in current research on early language learning differ not only in their favored questions and methodologies, but also in how they conceptualize children’s language competence and dimensions of the linguistic environment thought to contribute to this competence. The first and oldest paradigm (e.g. Brown, 1973) relies on detailed observations of children’s speech productions as well as the parental speech that constitutes the early language input to the child (see Clark, 2003; Tomasello, 2003). As the child moves from one-word to more complex utterances, growth in competence is observed in productions that increasingly approximate adult models in terms of their phonological, semantic, syntactic and pragmatic appropriateness. Such descriptive studies may be motivated by different theories about the factors that drive language learning, but they typically share two basic methodological principles relevant to this discussion. First, they are high in ecological validity, using naturalistic data and drawing on a diverse array of outcome measures for assessing language competence. And second, they are also concerned with fine-grained analyses of the language the child hears as well as what the child produces (e.g. Gallaway & Richards, 1994). An important goal of observational studies of early language input is to examine how children’s developing linguistic competence may be influenced by aspects of the speech they are exposed to in everyday interactions (e.g. Hoff, 2003; Huttenlocher et al., 1991; Pine & Lieven, 1997).

A second predominant paradigm uses experimental methods to investigate how children figure out what novel words refer to (e.g. Woodward & Markman, 1997). Here the measure of competence is typically defined in terms of a forced-choice behavior by the child, who might choose between familiar and unfamiliar objects when asked Which one is the dax? Because selection of the most appropriate referent is the correct response, such dependent measures are plausibly related to behaviors that children use spontaneously to reveal their understanding of language and thus seem reasonably valid. Experiments in this tradition define ‘language input’ in a very restricted sense, in terms of the linguistic cues manipulated as the independent variable. For example, when choosing between a solid object and a substance, does the child make a different choice when asked to find the dax as opposed to some dax? Other than that, the language background of the child has been relevant in only a few cross-linguistic studies, as when generalizations made by Japanese- and English-learning children were compared in a word-learning task (e.g. Imai & Gentner, 1997). While studies in this tradition are high in experimental control, they are lower in ecological validity than are naturalistic studies, and the issue of language input is rarely relevant.

The third major approach in research on early language learning is the field of infant speech perception, which has gained in influence through the work of Jusczyk (1997), Kuhl (2000), Saffran (2003), Werker (1995), and others. This research explores how infants develop sensitivity to regularities in the ambient language months before they are able to find meaning in speech or to speak themselves. Thus investigators cannot use response measures that require skill in comprehension or production and their methodological options are limited. The experimental procedures in this area all in one way or another test the ability of the infant to discriminate one type of speech sound from another based on perceptual properties or higher levels of organization among the stimuli. For example, auditory preference procedures might be used to compare infants’ overall listening time to type A stimuli versus type B stimuli (e.g. French vs. English, or infant-directed vs. adult-directed speech) to determine whether infants at a certain age can distinguish between them. The dependent measure is a listening bias or preference, operationalized as longer mean listening time to one or the other sets of stimuli across trials; thus the measure of ‘competence’ in this procedure is captured by a single difference score. Other methodologies employ different but comparable response measures, including conditioned head turns (Kuhl, 2000) or dishabituation (Stager & Werker, 1997) to changes in sound from one category to another.

These kinds of measures have been used in hundreds of studies to document developmental changes in infants’ awareness of the structure of speech sounds on phonological and other levels (see Aslin et al., 1998), so there is no doubt as to their utility. But it is important to note that the relation between infants’ phonological knowledge and their performance on such experimental measures – i.e. small mean differences in attention to one stimulus type over another – is not straightforward. Moreover, in some
studies researchers find a significant preference for the more familiar stimulus type (e.g., Jusczyk & Aslin, 1995), while in others the less familiar type is preferred (e.g., Saffran et al., 1996), a difference not always easy to make sense of. The point here is that the connection between an infant’s phonological competence and a single measure of listening time in an auditory preference experiment seems much less transparent and ecologically valid than does the connection between a child’s lexical knowledge and the ability to speak or respond appropriately to familiar words. And this point may be particularly noteworthy in relation to studies of infants growing up in multilingual environments.

**Extending Research on Early Speech Perception to Infants Learning Two Languages**

Before discussing recent efforts to extend this research to investigations of bilingual learning in infancy, a few of the major findings with monolingual infants will illustrate how productive this paradigm has been. Studies using auditory preference and other measures of discrimination show that infants in monolingual environments can distinguish between the ambient language and another language they have never been exposed to as long as the two differ in their basic rhythmic structure (e.g., Nazzi et al., 2000), suggesting that even very young infants are attentive to prosodic features characteristic of what will be their native language. Infants also start early to absorb detailed information about regularities at the segmental level in the speech they are hearing, and begin to ‘specialize’ in their native language over the first year. While young infants can initially discriminate speech sounds not present in the native language, their performance in distinguishing non-native contrasts declines by the end of the first year as they become more proficient in categorizing those phonemes used in the ambient language (e.g., Werker, 1995; Kuhl, 2000). Note that in all of these cross-linguistic studies with monolingual infants, language input is represented in the independent variable in terms of a simple dichotomy between ‘native’ speech sounds (i.e., from the one language the infant has been exposed to) versus ‘non-native’ speech sounds (i.e., from some language the infant has never heard before).

While infant speech perception research has focused almost exclusively on infants in monolingual environments, a few recent studies have included children learning two languages from infancy, referred to as ‘bilingual first language acquisition’ (BFLA) (e.g., de Houwer, 1995). Two questions have motivated these studies. First, if monolingual infants show a listening bias for the one language they are familiar with (e.g., Nazzi, et al., 2000), do BFLA infants show biases for both languages they are hearing?

And second, given that monolingual infants appear to lose sensitivity to non-native speech contrasts over the first year (e.g., Werker & Tye, 1984), do BFLA infants maintain the ability to discriminate speech sounds in more than one language? Working in Barcelona with infants learning either Spanish or Catalan as their first language, or both languages simultaneously, Bosch and Sebastián-Gallés (1997) tested 4-month-olds on their responsiveness to the language spoken by the child’s mother (either Spanish or Catalan) and to English, unfamiliar to all the infants. Monolingual infants were significantly faster to orient to speech sounds in the maternal language than to speech in English. In contrast, BFLA infants oriented more slowly to speech in the maternal language than to English speech, and were slower overall to orient to either language than were monolingual infants, an unexpected pattern of results.

In a later study, Bosch and Sebastián-Gallés (2003) tested infants across the first year on their ability to discriminate the vowel distinction /ε/-/ε/ which occurs in Catalan but not in Spanish. As predicted, monolingual infants learning Catalan could make this distinction at 4, 8, and 12 months, while those learning Spanish discriminated the Catalan distinction only at 4 months and not at later ages. However, BFLA infants exposed to both Catalan and Spanish responded inconsistently, discriminating the Catalan /ε/-/ε/ at 4 and 12 months but not at 8 months. In other recent research comparing monolingual and bilingual infants in standard speech perception tasks, Werker et al. (Chapter 1 this volume) and Vihman et al. (Chapter 3 this volume) also report unexpected findings. For example, Burns et al. (2003) examined discrimination of French and English speech contrasts by infants learning either French or English, or both languages simultaneously. Consistent with previous findings, monolingual infants lost the ability to make the non-native discrimination over the first year, but retained the ability to discriminate speech sounds in the language they were learning (see Werker, 1995). If early and consistent exposure to a particular language accounts for this effect, one might expect that children hearing two languages would maintain their ability to make discriminations in both languages. However, Burns et al. found that half the French/English bilingual children at 14 to 17 months of age made only one distinction, but not both. Werker et al. (this volume) also describe another recent study in which bilingual children were delayed relative to monolinguals, in that children exposed only to English could discriminate an English speech contrast at an earlier age than did BFLA children exposed both to English and to another language at the same time.
Interpreting Discrepant Results from Speech Perception Experiments with Monolingual and Bilingual Infants

According to Kuhl (2000), research on the early development of speech perception abilities indicates that infants in monolingual environments become increasingly specialized in a particular system of speech sounds, making a ‘neural commitment’ to the phonological system of their native language by the end of the first year. This view leads to the prediction that infants in bilingual environments would show specialization in two different languages over the same period. However, when compared with monolingual infants in standard speech perception experiments, it appears that BFLA infants are relatively less able to distinguish the sounds in their two languages either from each other or from those in a third unfamiliar language (Bosch & Sebastián-Gallés, 1997, 2003; Vihman et al., this volume; Werker et al., this volume). If increasing specialization in the native language as shown by differential listening and discrimination is interpreted as ‘progress’ in phonological development by monolingual infants, then how should we interpret the negative results found in some studies when bilingual infants are tested in the same experimental procedures?

Given the additional challenges BFLA infants face in learning two different language systems simultaneously, there are several reasons why they might perform differently than monolingual infants in speech perception tasks assessing listening biases. One possibility is that BFLA infants hear less speech in either language than monolingual infants hear in the single language they are exposed to, and this reduction in language-specific input might result in slower development of speech perception skills. Although no studies have investigated whether the amount of early linguistic input influences speech perception abilities in infancy, studies at later ages show that the amount and quality of language heard by the child are correlated with measures of lexical and syntactic growth (e.g. Hoff, 2003; Huttenlocher et al., 1991). There is also some evidence that individual differences in speech perception abilities by monolingual infants predict differences in later vocabulary growth (Tsao et al., 2004). That is, monolingual infants who for whatever reason performed less reliably in a vowel categorization task at 6 months of age tended to be somewhat slower in lexical development a year later, as compared to infants who were more successful in the experimental procedure. If BFLA infants performed less well overall than monolingual infants in this particular speech perception task (as they appear to do in other such tasks described earlier) would this difference also predict slower vocabulary growth later in either or both of the languages they are learning? There is no research on this question, but this prediction might seem plausible if the rather erratic performance of bilingual infants in speech perception studies to date is interpreted in terms of ‘failure’ or ‘delay’.

In interpreting what appear to be negative findings in speech perception studies with infants exposed to two languages, it is crucial to keep in mind the two questions about experimental paradigms in this research tradition that were outlined earlier. First, how is linguistic competence operationalized in such research and how clearly are the experimental measures linked to children’s knowledge of language? And second, if the linguistic environment of the child is relevant to the research question, how adequately is early language experience characterized and assessed? Regarding the measure of competence, early speech perception studies all necessarily rely on indirect measures that involve differential listening to different sets of speech stimuli, reflecting the child’s recognition of one set as more familiar or novel than the other. In many auditory preference experiments, one could gloss the child’s listening bias as ‘I find this engaging because I’ve heard it before’, while in habituation studies the listening bias is in favor of more novel stimuli. But in either case, the infant is comparing sounds that are more familiar with sounds that are unfamiliar or relatively novel. Thus when monolingual French-learning infants are presented with speech samples from both French and Russian, the choice is between highly familiar speech sounds and speech sounds never heard before (Mehler et al., 1988).

Given that speech perception experiments assess phonological competence by asking infants to discriminate between speech stimuli designed to be very familiar or novel to the child, the task demands may be inherently different for bilingual and for monolingual infants. Here is where the issue of language input becomes a crucial consideration. In studies with BFLA infants, the language background of the child is typically described in terms of the percentage of time the child hears each of the two languages spoken in the family, based on parental report. For example, the criterion for the BFLA classification in a particular study might be that a child hears Spanish no more than 60% of the time and English at least 40% of the time. This is a difficult measure to assess in any case, even with newly developed parental questionnaires that attempt to provide more detailed descriptions of both qualitative and quantitative features of children’s linguistic environments (e.g. Marchman et al., 2000).

A fundamental problem here is that because the sounds of the speech heard by the infant are not captured by questionnaire data, the characterization of the input as 60% Spanish and 40% English is an idealization that could be quite misleading. In reality, the child may hear 40% Spanish from a native speaker (e.g. the mother), 20% English from a native speaker (e.g. the father or daycare provider), with the additional 40% of the input con-
sisting of Spanish spoken by native English speakers and English spoken by native Spanish speakers. These latter mixed categories are not uncommon in bilingual families, when one parent uses the language of the other, or when other bilingual relatives and neighbors speak their second language with an accent influenced by their first language. Thus at the phonological level, four rather than two categories are needed to characterize the sources of language input to this hypothetical child: native Spanish, native English, Spanish-with-English-phonology, and English-with-Spanish-phonology. Moreover, the latter two categories are likely to be heterogeneous with considerable variability in the speech sounds used, given that different individuals will be proficient to different degrees in speaking L2. The result is that the infant will be exposed not only to two different languages in their standard forms, but also to two classes of highly variable input in which Spanish phonology is overlaid on sentences using the lexicon and grammar of English, and vice versa.

How would such phonological diversity in the early language environment influence the performance of BFLA infants in speech perception tasks? It seems likely that experiencing heterogeneous input of this sort at the very beginning of language learning could have two consequences relevant to interpreting the results of these studies. First, it would be more difficult for BFLA than for monolingual infants to distinguish one language from another, given that bilingual infants regularly hear speech from different sources in which there is continuous variation from one language to another on the phonological level. A related point is that BFLA infants would also be less likely to perceive phonetic contrasts as categorically different if they had experienced tokens of these speech sounds on a gradient from one to the other. In the study by Bosch and Sebastian-Galles (2003), for example, the Catalan/Spanish bilingual infants may have failed to discriminate the Catalan /e/-/e/ contrast consistently because they had frequently heard these vowels pronounced incorrectly by Spanish speakers of Catalan who do not make this distinction in their native language. Thus the ‘failure’ of the BFLA infants to show evidence of making categorical distinctions between phonemes in the languages they are learning may reflect the fact that category boundaries are less well defined in the distributions of speech sounds they hear than in the speech to which monolingual infants are exposed. While auditory preference and discrimination tasks can reveal whether the child perceives one set of speech sounds as familiar and the other as unfamiliar, an appropriate paradigm for use with monolingual children, BFLA infants have typically had extensive experience with a wider distribution of speech sounds that may not map cleanly onto the categories experienced by the infant who hears only one language spoken by native speakers.

Conclusions

Although there is still very little research on individual differences in infants’ ability to categorize speech sounds, there is convincing evidence that typically developing monolingual infants make progress in mapping out the phonological categories of the ambient language over the first year (Kuhl, 2000; Werker, 1995), and also some preliminary evidence that monolingual infants who are slower to develop such capacities may be less advanced in vocabulary learning in the second year (Tsao et al., 2004). However, because infants hearing two languages face quite different challenges than do those exposed to a single language spoken only by native speakers, the bilingual child should not be viewed as ‘two monolinguals in one’. Rather than distinguishing two separate systems of language-specific phonological categories by the end of the first year, BFLA infants may initially form broader categories that reflect the nature and variability of the input; and if so, it is hardly surprising that they perform differently from monolinguals in standard speech perception tests. The question of interest here is whether the apparent ‘delays’ in categorization abilities reported for BFLA infants are in any sense predictive of delay in later language learning, as they may be for monolingual infants, or whether such performance differences simply reflect patterns of phonological development that are inevitably different for monolingual and bilingual infants.

Before we can interpret the results of speech perception experiments with bilingual infants with any confidence, we need to consider the two questions with which we began: First, how broadly do these speech perception tasks capture the emerging language competence of the BFLA infant? And second, how much attention do researchers in this tradition pay to details of the child’s early language environment that are likely to influence this emerging competence? Regarding the first question, the dependent variables used in speech perception experiments are exceedingly indirect measures of language competence that are often quite difficult to interpret. Until more is known about the test-retest reliability and predictive validity of these early listening measures in relation to traditional measures of productive and receptive language competence, we should be extremely cautious in drawing conclusions about what listening biases actually reveal about the state of children’s knowledge at a particular age. Moreover, it seems unlikely that listening measures in infancy will be correlated with later language measures in the same way for bilingual and monolingual children. Regarding the second question, studies of infant speech perception have never included the detailed assessments of the child’s language environment characteristic of naturalistic research on

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language development, although such data are especially important in research with bilingual children. Infants growing up in multilingual environments not only hear two different languages spoken with native phonology, they are also likely to hear one or both of these languages spoken with a non-native accent. Thus BFLA infants are exposed in varying degrees to non-standard as well as standard versions of each language. If research with bilingual infants were based on detailed analyses of the full range of phonetic variability in the speech they are actually hearing, rather than on idealized estimates of the percentage of input in a particular language, it would be possible to make more informed predictions about the development of phonological awareness in children who grow up hearing two languages.

References


