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Research Focus

Native-language sensitivities: evolution in the first year of life

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In the first few months of their lives, human infants can perceive differences in phonetic contrasts not present in their environment and that their parents cannot discriminate. At 12 months, their pattern of discrimination approaches that of their parents. Until recently, it was believed that the perception of native-language categories did not significantly evolve in that period. Kuhl *et al.* offer compelling new evidence indicating significant increase in native-language perception.

When learning a foreign language, most people find some particular non-native phonetic contrasts very difficult to perceive. Fascinatingly, if these same individuals had been tested at birth, they would have had no difficulty in perceiving the very same contrasts. Starting with the seminal works of Eimas *et al.* and Werker *et al.* [1,2] it has been known that very young human infants are able to perceive all human-language contrasts (at least all that have been tested until now). But between 6 and 12 months of age, their ability to perceive some non-native sounds declines. Different studies have explored the pattern of this decline, but not much attention has been devoted to the analysis of how native contrasts are processed in the period from 6 to 12 months. It could be argued that this is because native-category perception does not seem of much interest, as discrimination occurs throughout life. Recently, Kuhl and co-workers [3] explored the perception of both native and non-native speech sounds during this particular period. Their results demonstrate not only that infants show a decline in the perception of non-native sounds, but that they also show a refinement in the perception of the native ones.

The role of experience in early language development is the focus of intense debate. The existence of categorical perception at birth is solid evidence of the existence of at least some innate predispositions to perceive the speech signal in a specific way. Nevertheless, the decline occurring between 6 and 12 months for non-native categories indicates that experience also has a deep impact during this early period. The perceptual reorganization taking place in these months has been assumed to be the result of qualitative changes in the underlying speech perception mechanisms. According to this assumption, infants are able to perceive any speech contrast in the first months of life because they can use general perceptual acoustic capacities. From 6 to 12 months, as a consequence of their experience with their native language, language-specific mechanisms are now available to process the speech signal. Although studies indicating a decline in non-native discrimination are both abundant and consistent, the evidence addressing the evolution of native contrast discrimination in the 6–12 months period is scarce and controversial. Are native-language categories immune to perceptual reorganization?

Native-language speech category perception

Categorical perception is characterized by an enhanced capacity to perceive exemplars belonging to different categories, but difficulty in the perception of different tokens belonging to the same category. An extreme position of categorical perception for speech categories assumes that variations below the level of phoneme are not used by linguistic processing [4]. With a few exceptions, the predominant view about adult phoneme category perception has supported this position. The fact that, as Eimas and co-workers showed, 2-month-olds display a pattern of discrimination consistent with this extreme view facilitates the straightforward assumption that perceptual reorganization affects mostly non-native categories.

Kuhl *et al.* have directly addressed the issue of native-language speech category development. To do this, they used one of the most pervasive (and well documented) non-native contrasts: the perception of the English /r/ and /l/ phonemes by Japanese listeners. The procedure they used was the conditioned 'head turn'. In this procedure, infants are trained to turn their head towards an attractive toy every time they hear a change in a background stream of repetitive syllables. If infants can perceive the contrast, they will turn their head towards the rewarding toy, but they will not orientate if the contrast cannot be perceived. They tested monolingual American and Japanese infants with ages ranging from 6–12 months.

The results of Japanese infants replicated previous studies. At 6–8 months of age they turned their heads significantly above chance when a change occurred (similarly to their American peers). At 10–12 months, Japanese infants showed a decrease in their discrimination of the /ra–la/ contrast. They obtained new results, however, in the pattern of discriminations of American infants. These infants showed a significant *increase* in their responses to the native contrast over the age range (from 63.7% at 6–8 months to 73.8% at 10–12 months).

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Kuhl *et al.* conclude that therefore perceptual changes affect both native and non-native category perception.

Native-language speech category sensitivities

It might be argued that the improvement in discrimination shown by 10–12 month-old American infants reflects a general development in their capacity to respond to significant discriminations. The improvement could be the result of an enhancement of general perceptual or attentional mechanisms taking place at this age. Two lines of evidence can be brought to support this hypothesis. First, important developmental changes in the maturation of the central auditory system in the first two years of life have been reported [5]. Specifically, two important periods of development have been suggested, one at around 6 months and the other around 9 months, demonstrated by ERP morphological changes to tonal contrasts. Second, in Kuhl *et al.*'s experiment infants were required to orient to an attractive toy, and the orientation/attentional network does indeed mature in this period [6]. Japanese infants could not show an improvement because they were no longer perceiving the contrast.

However, in spite of these arguments, there is converging evidence to support Kuhl *et al.*'s hypothesis that their results reflect the specific development of native-language categorical perception. Several studies have indicated that infants at 6–12 months are sensitive to patterns of variability within native-language phonetic categories and that they use this information to build up their linguistic knowledge. Maye *et al.* [7] showed that infants' speech categories can be rapidly modified by passive exposure to different distributions of exemplars of particular categories. Jusczyk *et al.* [8] showed that 10.5 month-old infants (but not 9-month-old infants) use within category distinctions to segment words. For instance, they observed that 10.5 month-olds were sensitive to the different pronunciations of the phoneme /t/ in '*night rates*' and *nitrates*. And McMurray and Aslin [9] observed that 8-month-old infants who were repeatedly exposed to words starting either with /p/ or /b/ were able to detect subtle variations both within and between categories. Studies addressing the development of speech categories in infants raised in bilingual environments [10] also support the impact of linguistic exposure in this age range: Spanish and Catalan infants showed different patterns of discrimination to a vowel contrast present only in Catalan (see Figure 1).

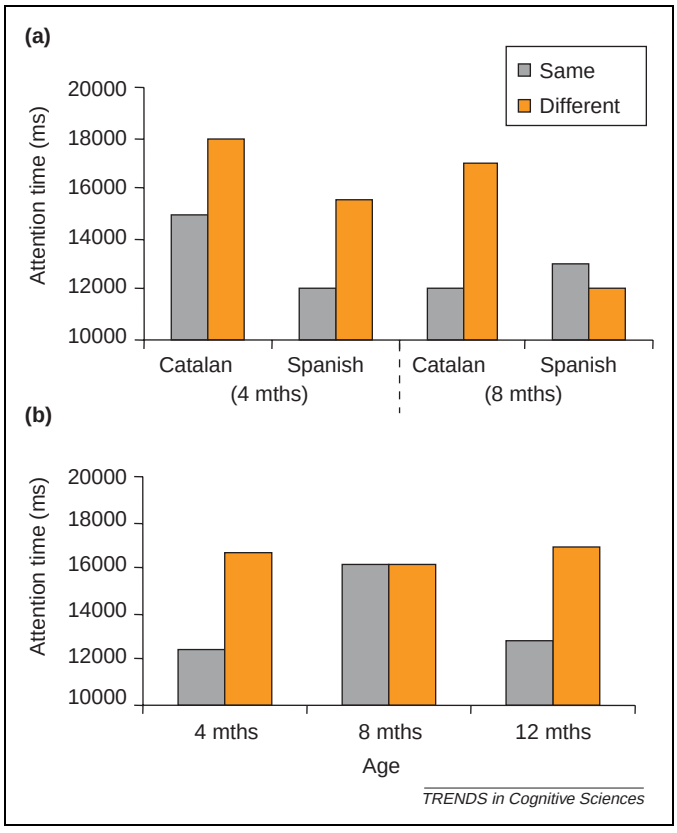


Figure 1. Measuring the effects of bilingual exposure in early phoneme category learning. In the experiments of Bosch and Sebastian [10] **(a)** 4- and 8-month-old infants from monolingual (Catalan and Spanish) and **(b)** bilingual (Catalan–Spanish) infants were tested with a familiarization-preference procedure on a vowel contrast present only in Catalan: /e–ɛ/ (adult Spanish native listeners show great difficulties in perceiving this contrast). As expected, all 4 month-olds showed discrimination, regardless of the language of exposure. By 8 months, only infants from Catalan monolingual environments succeeded. Although the results of the Spanish group were expected, those of the bilingual group were not. By 12 months, bilinguals achieved discrimination (Redrawn with permission from Ref. [10]).

Directions for the future

The recent evidence from infant studies, including those of Kuhl *et al.*, in the domain of native and non-native speech category learning provides compelling evidence for the existence of an increase in the refinement of phonetic categories during the first year of life. In contrast with previous approaches supporting a rather static view of native category development, the evidence gathered in recent years points in the direction of complex dynamics underlying the structure of native speech categories.

Nevertheless, knowing that improvement of performance in category perception occurs is different from understanding the underlying mechanisms of this refinement. The period from 6 to 12 months is a very active period in language development. In particular, infants acquire different types of phonological knowledge that will eventually lead to successful word segmentation and word learning. Is the increase in phonological knowledge driving the refinement of the phonetic categories? Alternatively, are basic perceptual and category learning mechanisms the underlying forces constraining the refinement of phonetic categories? If so, how does this refinement relate to the rest of phonological (and lexical) representation? Future studies of this interplay will provide significant milestones in the understanding of our native language development.

References

1 Eimas, P.D. *et al.* (1971) Speech perception in early infancy. *Science* 171, 304–306
2 Werker, J.F. and Tees, R.C. (1984) Cross-language speech perception: Evidence for perceptual reorganization during the first year of life. *Infant Behav. Dev.* 7, 49–63
3 Kuhl, P.K. *et al.* Infants show a facilitation effect for native language phonetic perception between 6 and 12 months. *Dev. Sci.* (in press)
4 Liberman, A.M. *et al.* (1957) The discrimination of speech sounds within and across phoneme boundaries. *J. Exp. Psychol.* 54, 358–368

5 Jing, H. and Benasich, A.A. Brain responses to tonal changes in the first two years of life. *Brain Dev.* (in press)
6 Richards, J.E. (2003) The development of visual attention and the brain. In *The Cognitive Neuroscience of Development* (Haan, M.D. and Johnson, M.H., eds), pp. 73–93, Psychology Press
7 Maye, J. *et al*. (2002) Infant sensitivity to distributional information can effect phonetic discrimination. *Cognition* 82, B101–B111
8 Jusczyk, P.W. *et al*. (1999) Infants' sensitivity to allophonic cues for word segmentation. *Percept. Psychophys.* 61, 1465–1476
9 McMurray, B. and Aslin, R.N. (2005) Infants are sensitive to within-category variation in speech perception. *Cognition* 95, B15–B26
10 Bosch, L. and Sebastián-Gallés, N. (2003) Simultaneous bilingualism and the perception of a language specific vowel contrast in the first year of life. *Lang. Speech* 46, 217–244

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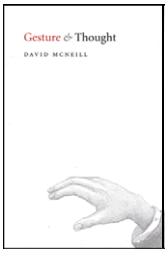
Book Review

The growth of the growth point

Gesture and Thought by David McNeill. University of Chicago Press, 2005. $38.00/£28.00 (318 pp.) ISBN 0-226-51462-5

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Ever since psychology emerged as a science in the late 19th century, psychological theories have repeatedly defined themselves in oppositional contrasts: the static (e.g. Titchener's structuralism) versus dynamic (e.g. Angell's functionalism), and the holistic (e.g. gestalt psychology, Tolman's purposive behaviorism) versus analytic (e.g. Hull's S–R learning theory, modern-day information-processing). Occasionally, some brave soul (such as the Russian developmental psychologist, Vygotsky) will call attention to these oppositions and even attempt some sort of reconciliation between them; but until now, nobody has managed to do this with lasting success. Whether David McNeill's newest book, *Gesture and Thought* – radically influenced by his reading of Vygotsky – will achieve this goal, only the future can tell; but there is no question whatsoever that it is a major contribution to this effort.

In 1992, McNeill published *Hand and Mind*, the foundational text in the psychological study of gesture. Despite great progress in gesture research over the past two decades, *Hand and Mind* is still the first book given to any student aspiring to work in the area and remains the 'bible' for many senior gesture researchers. Whereas the emphasis in 1992 was on how thought is revealed in gesture, the current work focuses on how gesture participates actively in speaking and thinking. Indeed, McNeill presents nothing less than a full-fledged theory of utterance generation in the service of thinking.

The theory is constructed around several fundamental principles. The first is that each nascent idea unit is a 'Growth Point' (GP) constituted by a dialectical opposition between two contrasting yet simultaneous modes of structuring meaning: (1) spatial, analog, holistic, imagistic and (2) sequential, digital, combinatorial, linguistic. McNeill terms this the 'imagery–language dialectic'. The second principle is that meaning in both modes involves the differentiation of a 'newsworthy' contrast from a context of possible contrasts, so that context always inhabits the core of the GP. The third is that the dialectical opposition between the imagistic and linguistic modes of the GP and its need for resolution both drive and are concretely enacted in synchronous, co-expressive gesture and speech. The fourth is that it is by dynamically unpacking the GP in an utterance consisting of gesture and well-formed linguistic structures that this resolution is achieved; and the fifth is that it is through this dynamic process of utterance generation that thought takes shape and enters the speaker's concrete experience. Put more simply, for McNeill gesture, speech, thought and experience constitute a single system in the most profound sense.

Having articulated the GP model, McNeill then uses it in semantic analysis, and to elucidate issues in ontogenesis, language effects on thinking, neural underpinnings of the GP, and the evolution of language. The semantic analysis unfolds in a brilliant case study illustrating the sophisticated, multi-faceted approach that the theory supports. In such an analysis, identification of the meaning contrasts underlying a given GP exploits evidence provided not only by the semantic content and grammatical construction of the co-expressive speech, but by the moment of gesture–speech synchrony, the form of the gesture movement co-expressive with speech, the timing of gesture preparation, and clues to meaning context provided by recurrences of gesture forms that index cohesive linkages in the discourse.

Discussion of ontogenesis and the effects of language on thinking reflect McNeill's view of the role of the imagery–language dialectic in the dynamic expression of thought and the reconstruction of experience during the process of utterance formation. With regard to ontogenesis, he makes an intriguing case for ties between the development of the dialectic and children's growing awareness of self as agent and understanding of other minds. With regard to the

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