

Discussion

Comment on [Werker and Tees \(1984\)](#) cross-language
speech perception: Evidence for perceptual
reorganisation during the first year of life

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Study on early infant language development (and in general infant development) has undergone a dramatic expansion in the past years. Some of the fundamental issues that are currently being addressed can be traced back to a few articles, such as the article by [Werker and Tees \(1984\)](#) (W&T). This article impact has not lessened with time; on the contrary, like good red wine, it has improved with age. I will now address two aspects of the article that I believe have made it an article with a huge impact in the field of infant research.

Nowadays nobody questions that infants are born with the capacity to distinguish phonetic contrasts not-existing in their maternal language. It is also indisputable that adults show remarkable difficulties in perceiving some foreign contrasts. This was known in the early eighties, as the references mentioned in the W&T's article introduction show. It is not a surprise, then, that W&T stated that one of main aims of their research was to "identify the developmental time period within which the decline in non-native speech perception might occur" (p. 50). Nevertheless, the experimental work had a much broader scope. An important property of that study, which is in fact a "rare" property in developmental research, is that it related infant data with general theories on speech perception (the same could be said, though, for adult studies in the sense that few "adult" studies try to link adult and infant data). To summarise W&T's work by conducting that it shows that between 8 and 12 months, there is an evident decline in infant's perceptual discrimination capacities of non-native contrasts, is to do an injustice to the article. In fact, this is not a conclusion, but a mere description of the data. Many developmental studies are just descriptive in nature: the goal is to be able to specify when infants or children are able to show a particular behaviour. Collecting descriptive data is a fundamental step in order to

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build up theories and, clearly, the domain of infant language development was far from having gathered a large set of descriptive data in 1984. In this sense, the W&T article would have been very important if it had just showed that there is a decline in some perceptual discriminations so early in life. However, the authors did not stop their conclusions here and took an important further step. They accounted for their results in terms of a general theory about speech perception: the motor theory (Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). This gave an extraordinary relevance to this article, both for the field of language processing in particular and for theories about cognition in general. The general perspective taken by the authors can be seen in the last sentence of the paper. It addresses one of the major questions of cognitive research that of “ascertaining whether the changes identified in both speech perception and production performance are mediated by general changes in cognitive functioning, or whether they are more a function of specific perceptual learning” p. 62).

The second general issue I want to address relates to the current importance of this work. In spite of the 18 years elapsed since its publication, it continues to be a major reference. Why is that? The last 10 years have been characterised by a tremendous growth of research addressing questions about the biological substrate of cognition. Studies of the developmental brain (and mature brain) have put on the front page of research agendas the issue of the impact and consequences of particular environmental stimulation. If, as the work of W&T showed, as early as 8–12 months, a substantial perceptual reorganisation has already taken place, two immediate questions arise about the role of the previous experience in the perceptual reorganisation and about the brain changes underlying this reorganisation.

The elegant design of W&T showed that experience was needed to observe perceptual reorganisation. The comparison of English vs. Hindi or Thompson infants (Experiment 2) showed that it was language experience and not a general developmental mechanism that was responsible for the decline. Fourteen years later, almost an identical experimental design was used by Cheour et al. (1998) to uncover the underlying brain mechanisms of the perceptual reorganisation observed by W&T. Cheour et al. analysed the ERP responses of three groups of infants: 6- and 12-month-old Finns and 12-month-old Estonians in the discrimination of /e/ and /ö/ vowels (existing in both languages) on the one hand, and in the discrimination of /e/ and /õ/, on the other hand (the last vowel only existing in Estonian). The MMN is a well-known ERP signature, sensitive to acoustic changes. When a stimulus is repeatedly presented and then a different stimulus appears, a MMN is produced by the different stimulus. Furthermore, the amplitude of the MMN increases with acoustic mismatch (larger MMN responses for larger acoustic differences). Previous studies have shown that MMN responses are attenuated for non-native vowels (Näätänen et al., 1997), when compared with the responses evoked by native ones. Measuring the MMN, Cheour et al. essentially replicated W&T's results. While 6-month-old Finns displayed MMN as a function of the acoustic distance between the contrasts /e-/ö/ and /e-/õ/, thus showing no language-specific response; 12-month-old Finns, showed an increase in the MMN for the (native) /e-/ö/ contrast and an attenuation for the (non-native) /e-/õ/ one. Twelve-month-old Estonians did not show such different pattern for the /e-/õ/ and /e-/ö/ contrasts, both of which are native to them. But, is there something new in these recent studies?

It can be argued that the Cheour et al. (1998) study (and other parallel electrophysiological studies) have not increased our knowledge about early infant development: head-turn responses are simply replaced by fancier ERP signatures. This is not the case, and, as we will see, some

of the speculations put forward by W&T in 1984 to account for the developmental changes may finally be confirmed by some electrophysiological studies.

Speech processing in adults normally involves larger areas in the left hemisphere (bilateral, but left-hemisphere weighted). However, this lateralisation is not present in the first months of life. For instance, [Dehaene-Lambertz \(2000\)](#) did not observe greater left hemisphere involvement in speech (phoneme) processing than in acoustic (tone) processing in 4-month-old infants. Similarly, the evidence of Cheour et al. described in the previous paragraph was obtained by using central (Fz and Cz) electrodes. Thus, the existing evidence points in the direction of no proof of early language lateralisation in the processing speech sounds.

What triggers language lateralisation? Is it pure maturation or are some specific language development achievements needed? W&T suggested that the perceptual reorganisation observed at the end of the first year of life, for meaningless speech sounds, might be related to the moment when “the child is beginning to understand and possibly produce sounds appropriate to his/her native language” (p. 62). Although no electrophysiological or brain imaging study has, to our knowledge, linked brain lateralisation and language production; some studies have pointed in the direction that lateralisation of some language aspects may be related to the development of the lexicon. Mills and co-workers ([Mills, Coffey-Corina, & Neville, 1993, 1997](#)) observed that infants with smaller lexicons (or language competence) produced less lateralised ERP responses when listening to word or non-words, when compared with infants with larger lexicons (or better language competence). These results held when age was kept constant, so maturational effects could not account for the pattern observed. It is true that these data have been obtained with older infants than those studied by W&T, but it is also true that Mills et al. analysed word comprehension and not just meaningless speech sounds. So, it might well be the case that the W&T’s speculation that lexical increase, contribute in the transformation of an “infant functioning” brain to an adult functioning one, at least for structures related with language processing, is correct. If this proves to be the case, we predict an even longer citation life for this article!

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