Language in the infant’s mind

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SUMMARY
We review recent work that shows that, during the early stages of language acquisition, molar properties such as prosody are important to the infant. We argue that the specification of these structures allows the infant to learn the language processing routines that adults employ.

1. INTRODUCTION
Some years ago, Mehler (1981) proposed that the syllable is a molar structure that plays the most salient role during speech processing. After reviewing limited empirical observations, he concluded that these structures play a central role in language processing and are independent of any specific language.

Today, the database has grown dramatically and it is difficult to maintain the proposal. However, we remain convinced that in some form it remains correct. Let us try to state once again what we take to be a central problem in speech perception. The speaker–hearer, regardless of his or her maternal language, utilizes molar structures to represent speech and access the lexicon. These molar structures are used by the child to acquire a lexicon in early childhood. Mehler et al. (1990) argue that models of lexical access that attribute a major role to top-down processing have intrinsic shortcomings, regardless of their descriptive adequacy. These models do not take account of the facts that children are committed to some sort of late quasi-cognitive shift of attention or bias rather than to specific modular language-processing routines (Best et al. 1988). However, psycholinguists have recently begun to focus on how these phonemes are organized into larger structures and how these larger structures play a role in speech processing. For instance, the data indicating that syllables intervene in language processing seem quite strong (Cutler et al. 1983, 1986; Dupoux & Mehler 1990; Sebastian-Galles et al. 1992; Pallier et al. 1993). However, speakers of different languages use different molar structures and compile processing routines from the rhythmical regularity in their respective maternal languages. Our research, and that of a number of colleagues from England, Canada, Japan and Spain, provides an empirical stand from which to claim that, besides the contrasting phonemic inventories of natural languages, the rhythmical structures they instantiate also affect our representations and processing algorithms. Language processing itself is moulded by the infant mind of the baby.
acquires the right processing algorithm to become mechanisms protect infants from falling into confusion
of language by paying attention mainly to the prosodic properties of speech. A consequence of this disposition is that it facilitates the classification of inputs according to the natural language from which they are drawn. It is much more difficult to decide from the above studies whether infants already react as if their maternal language was more familiar to them shortly after birth or whether such behaviour develops a few months later. Two recent experiments bear specifically on this issue.

Moon et al. (1993) assessed the preference of infants two days old, tested with Spanish and English sentences. Although all the mothers were monolinguals, half of them were Spanish-speaking and half American. Infants sucked during three periods of six minutes each. Moon et al. report that all infants sucked more during the third period, when they were listening to their mother’s native language, than when listening to the other language. The authors interpret this behaviour as showing that infants two days old prefer the native language of their mother.

G. Dehaene-Lambertz (in preparation) has adapted of a language relate to durational, energetic and pitch parameters that induce the perception of rhythm, stress and intonation. We hypothesize that there exist classes of natural languages that differ with respect to their prosodic characteristics. Thus, we entertain the hypothesis that infants first tune to a subset of languages and only at a later stage do they converge to the precise language spoken by their parents. Up to now, we have seen that infants use prosody at the level of whole sentences to keep languages apart. We shall now turn to the second main problem that the newborn infant encounters in the very first stages of language acquisition, namely segmenting the continuous speech stream into linguistically relevant units. There, too, prosodic structure may help the infants to bootstrap language acquisition, although this time at a level that specifies smaller units.

3. TUNING TO THE PROSODIC UNITS OF ONE’S MATERNAL LANGUAGE

The structure of language is discrete at several levels
utterances interrupted either at a boundary between two constituents, or somewhere within a constituent. To test the infants they relied on a modified version of Fernald's preference looking paradigm (Fernald 1985). Studies with American infants 9 months old, 6 months old and even 4.5 months old show that they

The studies carried out with infants seem to be highly dependent on the method that is used to assess their competence. Indeed, there is evidence from other paradigms, i.e. using lists of words instead of long samples of continuous speech, that infants younger than nine months have some knowledge of the
does not have to acquire them. In contrast, smaller prosodic units are not universal. Their form, and the way they are disjoined from one another, are all things that have to be acquired by infants. So far we do not have any notion of how they do this nor at what age the different units become available. We hypothesized that infants come prepared to segment speech into the relevant units regardless of language. Although the units may not be universal, they might fall into natural classes that the infant can characterize without too much trouble.

To investigate further the hypothesis that prosodic information is used by infants at a very early age to segment the speech stream into linguistically relevant units, Christophe et al. (1994) tested whether newborn infants are sensitive to the prosodic cues that might mark prosodic units. Christophe et al. (1994) used to ‘timing-units’. According to Fant and his colleagues, for each language ‘there can be a different basis by which a significant proportion of the variance in durational measures of speech can be accounted for’ (Fant et al. 1991). Traditionally, French, English and Japanese are described as syllable-timed, stress-timed and mora-timed, respectively (Abercrombie 1967). The traditional description captures the phenomenological experience reported by speakers of those languages. However, there is a compelling need for more data to support the above statements. Recent data from on-line psycholinguistic experiments suggest that parts of the processing routines of listeners depend on their maternal tongue, and in particular on the prelexical unit that is most prominent in their maternal tongue. To understand how speakers discover the pertinent routines for their language...
newborns noticed the addition of a new syllable only when it differed from the other syllables by its vowel. The salience of the vowel seems to be so critical to very young infants that under tests like the one described, the newborns even failed to notice the addition of the syllable /is/ in the context of /bi/, /si/, /li/ and /mi/. This series of experiments adds to our conviction that during the earliest stages of language acquisition vowels are central to the infants’ representations.

However, it would be premature to dismiss the syllable as a good candidate for the representation that infants construct during the habituation phase of the Bijeljac-Babic et al. (1993) experiment. Bertoncini & Mehler (1981) demonstrated that syllables have special status in the discriminations that infants 1 month old operate. This result was recently corroborated by Mood et al. (1992) using a very different method. How can one tease apart the options available to describe the infants’ early representations of speech?

To obtain a better understanding of this problem, J. Bertoncini, C. Floccia, T. Nazzi, K. Miyagishima, and J. Mehler (in preparation) explored whether infants are sensitive to other rhythmic units, such as the Japanese mora. The mora is a subsyllabic structure that includes all the CVs in the language, and the nasal N; geminate consonants and long vowels count as two moras. In a first experiment, the authors verified that French newborns still discriminated lists of bi- and trisyllabic words when Japanese words were used. In a second experiment, they used only bisyllabic words that differed in the number of moras: either two or three. In this experiment, no discrimination was obtained. These results show that infants born to French parents in Paris do not notice a change in the number of moras in the context of an unchanging number of syllables. The authors proposed that the trimoraic bisyllables are represented like the bimoraic bisyllables, on the basis of a periodicity that is initially given by the number of vowels they possess, i.e. two in each case. These results can be taken as supporting the view that newborns represent speech as a sequence of vowels. Of course, the infants’ behaviour may be guided by a more sophisticated representation. Possibly, the whole syllable is represented and the number of syllables counted. However, we suggest that infants first represent speech inputs in term of a sequence of vowels including some information about their duration and energy.

5. CONCLUSION
In the above sections, we have reviewed studies that incline us to believe that the human infant is born with a specialized mechanism for processing speech. This device allows infants to segregate utterances

nature of inputs. Rather, the linguistic stimulation they receive is organized into files in which knowledge of different phonologies is compiled. We have also shown that the baby precociously builds a template that makes it possible to rate inputs as belonging to the familiar system or as being foreign. Next, we turned to the segmentation problem, and showed that there is good evidence that infants build prosodic templates for word-sized units of their maternal language during the first year of life. Research on neonates suggests that even at birth infants are already sensitive to cues that demarcate prosodic units. Last, we reviewed existing experiments that inform us about the early representations that infants construct. We outlined an early predominance of vowels in these representations.

At all three levels considered, we referred to prosodic properties as responsible for the infants’ behaviour. Halle & Clements (1983, p.11) in their book on phonology state that intonation is ‘the “melody” with which a word, phrase, or sentence is pronounced’. For these authors, phonemes and intonational aspects of words as tones are represented on separated autosegmental tiers. For Selkirk (1984) two hierarchically organized structures are the essential parts of the phonological representation, namely, the prosodic constituent structure and the rhythmic structure. The former is the level that represents the groups of the units in the hierarchy while the latter represents a level where temporal periodicities are states. But still, it is to Roman Jakobson that we turn to obtain the clearest notional definition. In his book with Waugh he states that:

Characteristically enough, the prosodic features are a property of phonemes when functioning as syllabics and thus are primarily a property of vowels. In contradistinction to the relatively transient consonantal phonemes, vowels have been repeatedly delineated as relatively sustained, stationary units, prone to extension in time. Therefore they prove to be suitable for a set of prosodic features which are based on the contrastive comparison of a given vocalic phoneme with the vocalic phonemes of the surrounding syllables – stressed phonemes with unstressed ones, higher pitch with lower pitch, greater length with shorter length – or on the contrastive comparison of the beginning and the end on the temporal course of the syllable through the use of level and deflected tones in the different rising or falling modulations. (Jakobson & Waugh (1979), pp. 142–145).

We feel that the baby is in a similar predicament to the linguist because they are both aware that pitch, stress, duration and in general prosodic phenomena are essential to the description of languages. However, linguists have yet to provide us with a device that
as an informer who tells us, not only which structures are present in the language, but also in what order they have to be specified in order to converge to the parental language. In this sense, the studies we are conducting, with adults and with infants, will eventually generate much richer and more interesting frameworks than the ones that have arisen so far.

The preparation of this paper was supported by a grant from the Human Frontier Scientific Program, as well as by a grant from the Human Capital and Mobility Project.

REFERENCES


