

**Workshop**

**EARLY WORD SEGMENTATION:  
A CROSSLINGUISTIC APPROACH  
TAKING ADVANTAGE OF EUROPE'S  
LINGUISTIC DIVERSITY**

**Friday 25 - Saturday 26 February 2005**

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Location: ESPCI - 10 rue Vauquelin - 75005 Paris

[http://www.espci.fr/contact/plan\\_en.html](http://www.espci.fr/contact/plan_en.html)

Meeting room: amphi Schutzenberger  
(staircase N, 1st floor, left)

Closest metro stops: Luxembourg (RER B) or  
Censier-Daubenton (line 7)

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# Program

## EARLY WORD SEGMENTATION: A CROSSLINGUISTIC APPROACH TAKING ADVANTAGE OF EUROPE'S LINGUISTIC DIVERSITY

Friday 25 February 2005		Saturday 26 February 2005	
9.15	Opening remarks		
9.30-10.30	Summary of the English data 1. D. Houston	9.30-10.30	Research on other languages: infants (1) Chair: A Karmiloff-Smith 10. B. Hohle / J. Weissenborn 11. E. Johnson
10.30-11.00	coffee break	10.30-11.00	coffee break
11.00-12.30	Expected consequences of linguistic differences on segmentation Chair: S. Kern 2. M. Nespor 3. D. Bleses / H. Basboll 4. N. Vallée	11.00-12.30	Research on other languages: infants (2) 12. K. Plunkett 13. M. Vihman / R. dePaolis Discussion infant data
12.30-14.00	lunch	12.30-14.00	lunch
14.00-15.30	Word segmentation in French: diverging results Chair: S de Schonen 5. A. Christophe / S. Millotte / A. Gout 6. T. Nazzi / S. Frédonie / J. Bertoncini / G. Iakimova 7. L. Polka	14.00-15.30	Research on other languages: adults Chair: J. Bertoncini 14. A. Endress / M. Shukla / M. Peña / J. Mehler 15. S. Mattys 16. N. Sebastián / J. Toro / S. Mattys / L. Bosch
15.30-16.00	coffee break	15.30-16.00	coffee break
16.00-17.00	New approaches 8. V. Kooijman 9. T. Nazzi / A. Karmiloff-Smith	16.00-17.00	Discussion, concluding remarks, end of works
17.00-18.00	Discussion		

# Abstracts

**Derek Houston (talk 1)**

*Indiana University School of Medicine, Indianapolis, USA*

## **English-learning infants' segmentation of words from fluent speech: A summary of findings**

In a seminal study, Jusczyk and Aslin (1995) used a modified version of the Headturn Preference Procedure (HPP) to investigate English-learning (E-L) infants' segmentation of words from fluent speech. They found evidence that by 7.5 months of age, E-L infants can segment monosyllabic words from fluent speech. Since that study, a number of investigators have used the HPP to further explore E-L infants' segmentation skills. The picture that is emerging from these studies is that E-L infants' early speech segmentation is influenced by their sensitivity to the rhythmic properties of English words and by language-general factors, such as coarticulation, transitional probabilities of syllables, and lexical knowledge. By 11 months of age, E-L infants are able to incorporate additional cues into their segmentation strategies: phonotactic probabilities and allophonic cues. E-L infants' ability to segment word from fluent speech appears to be influenced also by whether the words are nouns or verbs. Taken together, these findings suggest that E-L infants may use multiple cues in parallel to segment words from fluent speech. Infants learning other languages likely use multiple cues to segment words from fluent speech as well. However, the cues that are used and the relative utility of each cue for segmentation may differ substantially across languages. We will discuss how the studies with E-L infants may and may not inform us about investigating speech segmentation in infants learning other languages.

**Marina Nespors (talk 2)**

*University of Ferrara, Ferrara, Italy*

## **Phonological differences in word segmentation**

In my talk I will take into consideration different mechanisms that have been hypothesized to contribute to early speech segmentation. For each, I will address the issue of the contribution of different phonological systems to the effectiveness of the mechanism. Both language specific and general acquisition mechanisms will be considered. The effect of different phonologies on word segmentation will be addressed in relation to the utilization of a) transition probabilities among syllables and segments, b) the identification of the rhythmic class, c) the location of word primary stress, d) phonotactic constraints. Particular attention will be given to the first mechanism, in relation with recent results concerning the utilization of the C tier in word segmentation.

**Dorthe Bleses & Hans Basboll (talk 3)**

*University of Southern Denmark, Odense, Denmark*

## **Danish sound structure – a challenge for early word segmentation?**

It has been shown that Danish children's early word acquisition is relatively delayed when compared to children with many other mother tongues. In this talk, we shall take a typological view on aspects of the Danish sound structure which may be a contribution factor to such results, together with important social conditions in present-day Denmark. Due to a complicated segmental phonology in Danish (not least the many close front vowels and the weak vowel reduction and consonant weakening processes), and a weakly signalled utterance prosody, some specific cues which have been studied and shown to be effective in other languages for segmentation purposes, are weak or non-existing in Danish. We will survey some potential cues in relation to the Danish sound structure and discuss their implications for segmentation. Preliminary results from a pilot segmentation experiment will be included in the presentation.

**Nathalie Vallée (talk 4)**

*Institut de la communication parlée, CNRS, Grenoble, France*

## **Universal syllabic patterns, lexical unit structures and sensori-motor constraints**

The aim of the communication will be the syllabic organization of lexical units. We will present results based on a 15 natural language database. We are interested in cooccurrences between phonemes of the same syllable and those of two consecutive syllables. Computed ratios between observed and expected syllables show that combinations are clearly favoured, others disfavoured, and we claim that some of them can be explained by sensori-motor constraints.

**Anne Christophe,\* Séverine Millotte\* & Ariel Gout\*\* (talk 5)**

*\*Labo. Sciences Cognitives et Psycholinguistique, EHESS-ENS-CNRS, Paris, France*

*\*\* CHU Bicetre, Kremlin-Bicetre, France*

## **Comparing French and American infants' early word segmentation abilities with two experimental techniques: HPP and word detection.**

In a recent paper we observed that American 10- and 13-month-olds exploit phonological phrase boundaries to constrain lexical access (e.g. they do not attempt to access to the word 'paper' in a sentence like 'the man with the least pay perspires constantly'; Gout, Christophe & Morgan 2004, *Journal of Memory and Language*). These results were obtained with a two-session variant of the conditioned head-turning paradigm that corresponds to a 'word-detection' task. We replicated these studies with French materials and infants. With French 16-month-olds we obtained results similar

to the American studies; in contrast, French 13-month-olds seemed to find it very hard to perform the word-detection task. There are two possible reasons for this cross-linguistic difference: 1. French may be harder to segment into words, initially, than American English; 2. there may be methodological differences between labs that make the technique more sensitive in Providence than in Paris. To attempt to distinguish between these two interpretations, we ran another series of experiments using another experimental technique, namely HPP (as used by Jusczyk & Aslin 1995). In a series of 9 experiments with infants aged between 8 months and 13 months, we observed a significant preference for familiar words only in 13-month-olds; a marginally significant tendency in two groups of 11-month-olds, and no difference in younger infants. Taken together, these results suggest that French infants find it hard to segment words from continuous speech before the age of 12 months, thus exhibiting a delay of several months compared to American infants. We discuss the possible reasons for this difference in behavior (language, culture...).

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### **Thierry Nazzi, Séverine Frédonie, Josiane Bertoncini & Galina Iakimova (talk 6)**

*Laboratoire Cognition et Développement, CNRS-Université Paris 5, France*

#### **The role of the syllable in early speech segmentation in French**

Studies with English-learning infants suggested that these infants start, segmenting speech into trochaic units, which correspond to the rhythmic unit of English to which the majority of bisyllabic English words conform. This trochaic based segmentation procedure would not be useful for French, given that lexical accentuation is weak and word-final in French, and the rhythmic unit in French is the syllable. Thus, the development of word segmentation in French should follow a different trajectory in which individual syllables play a more important role. We first evaluated whether French infants (from Paris) initially segment bisyllabic words as wholes, or if they segment their initial and final syllables independently. Neither 8- nor 12-month-olds appeared to segment bisyllables as whole units; final syllables started to be segmented between 8 and 12 months, while we found no evidence of the segmentation of initial syllables at 12 months. The results for the 12-month-olds are partly compatible with the hypothesis of the use of a syllable-based segmentation procedure for French. Moreover, the results at both ages show a lag in the emergence of segmentation abilities compared to results found for English and, more recently, for French Canadian infants. Indeed, Polka et al. (2003) found that French Canadian 8-month-olds can segment bisyllabic words, when the stimuli are recorded by a French Canadian speaker, but also when they are recorded by a Parisian French speaker. This different segmentation outcome might reflect differences in Parisian and Canadian French dialects, but could also reflect differences between the speech modes of the stimuli used with the Parisian infants (intonated adult-directed speech) and those used with the French Canadian infants (infant-directed speech). We will present new research exploring the role of speech mode, using Polka et al's Parisian French stimuli to test Parisian French infants.

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### **Linda Polka (talk 7)**

*McGill University, Montreal, Canada*

#### **Word segmentation in infants acquiring Canadian dialects of French and English**

In this talk we will present findings from our laboratory on segmentation of bi-syllabic words by infants who are acquiring English or French or both languages in Montreal, Quebec. Our studies build on previous findings with infants learning American English and provide data to compare segmentation of rhythmically different languages in infants who are exposed to rhythmically different languages. With respect to French, we have examined word segmentation in native language (Canadian French), cross-language (Canadian English vs Canadian French) and cross-dialect (Canadian French vs European French) conditions. Our findings to date show that infants acquiring Canadian French segment bi-syllable words when tested using French stimuli at the same age that English-learning infants show this skills for trochaic words in English (8 months) but they fail in a cross-language segmentation task (segmenting trochaic words in English). Work currently underway explores the segmentation strategies used by Canadian French and bilingual (French & English) infants. Potential explanations for discrepancies observed in segmentation behaviour of infants acquiring Canadian French and Parisian French will be outlined.

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### **Valesca Kooijman (talk 8)**

*University of Nijmegen - Max Planck Institute for Psycholinguistics, The Netherlands*

#### **Word segmentation from continuous speech: an ERP study with 10-month-old infants**

In their first year of life, before they start to speak, infants rapidly learn to deal with the sound structure of their native language. An important step in this first year of language acquisition is learning to recognize words in continuous speech (word segmentation). Behavioural studies have shown that infants learn to segment words from continuous speech between approximately 7 and 10 months of age. The predominant stress pattern of a language seems to play an important role in acquiring this skill. To study this step in language acquisition in more detail, we exploited an ERP repetition paradigm previously used in memory research, but in a novel way. The ERP procedure that we used had separate Familiarization and Test phases. In the Familiarization phase we presented 10-month-old infants with 10 tokens of a two-syllable word with stress on the first syllable. In the Test phase, which followed immediately after familiarization, we presented the infants with eight randomized sentences of which four contained the familiarized word. The remaining four sentences contained a new two-syllable word, also with stress on the first syllable. The Test phase shows an effect of Familiarity in the form of a negative-going deflection on the familiar words as compared to the unfamiliar words in the sentences. This effect starts well before the end of the critical word. This result shows that 10-month-old infants can indeed segment words from continuous speech. Moreover, the timing of the effect shows us that they only need roughly the first syllable of the word to begin doing this.

## [Thierry Nazzi\\* & Annette Karmiloff-Smith\\*\\* \(talk 9\)](#)

\* *Laboratoire Cognition et Développement, CNRS-Paris 5, Paris, France*

\*\* *Neurocognitive Development Unit, ICH, London, U.K.*

### **Early word segmentation by infants with Williams syndrome**

Studies with young children with Williams syndrome showed that although language constitutes one of their strengths in adulthood, word acquisition is initially very delayed. What could be the causes for such a delay? We know that the acquisition of a word requires (a) the representation of a sound pattern, and (b) the building of a corresponding concept that is then linked to the sound pattern. One study evaluated whether infants and children with Williams syndrome might have difficulties with the first of these two levels.

Accordingly, we investigated word segmentation, that is the process of extracting the sound patterns of words from the continuous speech stream. Typically-developing infants start segmenting words as early as 7.5 months of age, first by relying predominantly on prosodic information, and then start to take into account other cues signaling word boundaries: statistical information in the order of syllables, phonotactics, and allophony. As a result, English-learning infants start segmenting strong-weak nouns by 7.5 months of age, and weak-strong nouns by 10.5 months. Following Jusczyk et al. (1999), the head turn preference procedure was used to test the ability of 19 infants and toddlers with Williams syndrome (mean CA = 33 months; mean MA = 19 months), growing up in English-speaking families, to segment strong-weak and weak-strong nouns. They were first familiarized with instances of isolated nouns, and then tested on their recognition of these nouns embedded in passages. Our results at the group level suggest that our participants segmented the strong-weak, but not weak-strong words. Correlation analyses further suggested that strong-weak segmentation was present even in the youngest of our participants, while the oldest children might have started segmenting weak-strong words. This suggests that infants and toddlers with Williams syndrome are able to use prosodic cues to speech segmentation, while giving little weight or being unable to use statistical information. Hence, the delay in lexical development in Williams syndrome might partly originate in speech perception difficulties that develop early in typical development. This challenges claims that lexical acquisition in Williams syndrome is grounded on good phonological properties.

## [Barbara Höhle\\* & Jurgen Weissenborn\\*\\* \(talk 10\)](#)

\* *University of Potsdam, Potsdam, Germany*

\*\* *Humboldt University, Berlin, Germany*

### **Word segmentation in German learning infants: effects of rhythm and segmental information**

Like English and Dutch, German belongs to the stress timed languages with a dominance of the trochaic foot. In our presentation we will present data that show that German 6-month-olds prefer trochaic feet over iambic feet. Despite this early preference for the dominant foot structure of the target language the ability to segment trochaic words out of continuous speech did not show up before 9 months in German infants. In addition to the stress pattern of a word, the occurrence of a schwa syllable seems to be a reliable cue for word edges in German (e.g. Wiese, 1996). We will discuss recent experiments that focus on the question whether the vowel quality of a syllable is used as a segmentation cue by German 9-month-olds.

## [Elizabeth Johnson \(talk 11\)](#)

*Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands*

### **The developmental time course of speech segmentation by Dutch-learning infants**

The time course with which English-learning infants learn to segment fluent speech into linguistically relevant units has been well-defined. By six months, infants extract prosodically well-formed clauses and phrases from fluent speech. By 7.5 months, infants are able to extract smaller word-sized units from fluent speech, and this ability gradually becomes more accurate as infants' knowledge of the phonological structure of English matures. In the current talk, we will discuss this same developmental time course in Dutch-learning infants. Past research has suggested that Dutch-learning infants are slightly delayed with respect to English-learning infants in their ability to segment words from speech. We further explored the developmental trajectory of Dutch-learners' segmentation skills by testing Dutch-learning 6-month-olds' perception of clause boundaries in fluent speech. Despite the reported delay in Dutch-learners ability to segment words from speech, we found that Dutch learners are not delayed in their ability to segment clauses from speech. We are currently testing Dutch-learners ability to segment phrases from speech. At the same time, we have also been exploring Dutch-learning 7.5- to 10-month-olds' ability to segment words from speech. Our findings thus far are consistent with past reports, i.e., we found no evidence that Dutch-learning 7.5-month-olds can segment words from speech. Possible methodological and theoretical explanations for these findings will be discussed.

## [Kim Plunkett \(talk 12\)](#)

*Oxford University, Oxford, United Kingdom*

### **Learning how to be flexible with words**

One-year-olds have to identify tokens of words in continuous speech in rapid succession. The acoustic properties of embedded words vary with speaker identity, prosody and linguistic context, making word recognition and interpretation a cognitively demanding task. The current study reports on the degree of phonological detail that one-year-olds expect to be associated with words and their appreciation of the degree of variation that linguistic context imposes upon a word token. The study indicates that important changes occur in the flexibility of phonological representations of words, around the time of the vocabulary spurt. Underlying causes of these changes are discussed.



### **Rory DePaolis & Marilyn Vihman (talk 13)**

*University of Wales, Bangor, United Kingdom*

#### **The effect of 'personal knowledge' on infant segmentation**

The studies to be reported here build on Hallé and Boysson-Bardies' (1994) experiments with untrained word form recognition in French infants. We have replicated their findings with English children, who show such recognition at 11 but not at 9 months (Vihman, Nakai, DePaolis & Hallé, 2004), and who do so within 250 ms. of word onset (Thierry, Vihman & Roberts, 2003). Our current studies are designed to test two hypotheses regarding infants' segmentation abilities. First, we test infants at 11 months on their ability to use the familiarity with words that they have gained outside the experimental situation to segment short passages, in order to determine whether their spontaneously formed word representations can serve as entry points for segmentation. Second, we record spontaneous mother-child interactions in the home over a period of a few weeks in order to identify each child's most common production patterns. The infants are then tested on their attention to a short narrative passage containing disyllabic nonwords whose onset stop consonants match the infant's own most frequently used stop. We contrast that with two alternative passages which differ only in the inserted nonword forms: one set whose onsets are filled by another stop and one whose onsets are consonants rarely found in babble (/f/v/). The second study is based on the idea that an important source of linguistic input is the child's own output, which uniquely provides both auditory and proprioceptive feedback. Our experiments are based on the general idea that the infant's personal knowledge affects his or her experience of the world and eventually comes to drive the segmentation process.

### **Ansgar d'Endress, Mohinish Shukla, Marcela Pena & Jacques Mehler (talk 14)**

*SISSA, Trieste, Italy*

#### **Minding the edges**

We will present recent studies exploring how statistical and prosodical information interact when learning an artificial, non-segmented stream of speech. We will also present studies in which only segmented items were used. Both kinds of studies highlight the importance of edges, right or left, for encoding information.

### **Sven Mattys (talk 15)**

*University of Bristol, Bristol, United Kingdom*

#### **Not all cues should be trusted: An integrated, signal-contingent view of speech segmentation**

Current research with both infant and adult listeners indicates that word segmentation is promoted by both lexical (knowledge-driven) and sub-lexical (signal-driven) cues. However, an account of how these cues operate when combined or put in conflict is currently lacking. The present study fills this gap by assessing perceptual segmentation in adult English participants when cues are systematically pitted against each other. The results demonstrate that listeners do not assign the same power to all segmentation cues. Rather, a hierarchy of descending weights exists among lexical, segmental, and prosodic cues, respectively, with lower-level cues manifest when the interpretive conditions are altered by a lack of contextual and lexical information or by background noise. Taken together, the results call for an integrated, hierarchical, and signal-contingent approach to speech segmentation, with important implications for cross-linguistic and developmental research.

### **Nuria Sebastián, Juan Toro, Sven Mattys & Laura Bosch (talk 16)**

*Universitat de Barcelona, Barcelona, Spain*

#### **The relevance of stress cues in word segmentation: a cross-linguistic perspective**

Research on speech segmentation has claimed that language-specific stress patterns are applied to the processing of novel linguistic stimuli. However, some results could also be explained by the role of an attention mechanism that would highlight which features of the speech stream are preferentially taken into account for segmentation purposes. To further explore this issue, a series of experiments were run with native speakers of three languages that have different stress patterns (while English follows a SW rhythmic pattern, Spanish tends to stress the second-to-last syllable of content words, and French stresses the last one). Participants were exposed to an artificial language composed of tri-syllabic words in four different conditions: stress-flat (baseline condition), stress-initial, stress-medial and stress-final. It was hypothesized that speakers of each language would find segmentation easier in the condition that better matched their language-specific stress pattern. However, results showed no significant differences between speakers of different languages in the stress-flat, stress-initial and stress-final conditions and, for all of them, results in the stress-medial condition dropped to chance levels. The interplay between listeners' language-specific rhythmic knowledge and attention mechanisms towards salient features in the speech signal will be discussed. Additional data, on a pause detection task, using tri-syllabic, medially stressed natural strings, will also be presented.

### **CHAIRS OF SESSIONS:**

**Sophie Kern** - *Laboratoire Dynamique du Langage, Inst. des Sciences de l'Homme, Lyon, France*

**Scania de Schonen** - *Laboratoire Cognition et Développement, CNRS-Université Paris 5, France*

**Annette Karmiloff-Smith** - *Institute of Child Health, UCL, London, UK*

**Josiane Bertoini** - *Laboratoire Cognition et Développement, CNRS-Université Paris 5, France*