THE DEVELOPMENT OF LANGUAGE SPECIFIC PROSODIC PREFERENCES DURING THE FIRST HALF YEAR OF LIFE AND ITS RELATION TO LATER LEXICAL DEVELOPMENT: EVIDENCE FROM GERMAN AND FRENCH

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ABSTRACT

Several studies have demonstrated that infants are sensitive to prosodic cues from birth on and use this kind of information for their earliest steps into the acquisition of words and syntactic regularities of their target language. In the following we will report the results of four experiments with the headturn preference/discrimination paradigm we conducted with German infants between 4 and 6 months of age and with French infants at 6 months of age. Our study addresses the question of whether during this developmental period we can already find evidence that infants have determined the predominant trochaic pattern for bisyllabic words in their surrounding language. We presented 6- and 4-month-olds with trochaic or iambic bisyllabics in German and 6 month-olds with same stimuli in French. The German 6-month-olds showed a listening preference for the trochaic pattern, but not the German 4-month-olds nor the French 6-month-olds. However, 6-month-old French infants were able to discriminate trochaic from iambic bisyllabics. This suggests that the preference for the language dominant pattern of word stress arises between the age of 4 and 6 months in German. In French, in which there is little if any accentuation at the lexical level, French-learning 6-month-olds do not show a preference for any stress pattern, but they are sensitive to acoustic differences between trochaic and iambic bisyllables.

Keywords: acquisition, infants, prosody, French/German cross-linguistic comparison.

1. INTRODUCTION

It is a well established finding that from birth onwards, infants are equiped with a specific sensitivity to the prosodic information contained in the speech input. Soon after birth, they show a preference for the global prosodic features of their target language indicating that they must already have learned something about the prosodic characteristics of the target language [1]. In particular, it has also been shown that infants learning a language based on trochaic rhythm (in which most words are trochaic) develop a bias for trochaic words. This bias emerges between 6 and 7.5 months of age in English-learning infants, as shown using HPP [2]. An ERP study with German-learning 5-month-olds also showed an asymmetry in trochaic- iambic discrimination that can be taken as neurophysiological indication of a trochaic bias in this language [3].

Furthermore, recent research has provided evidence, at least for some languages, that prosodic information is also crucial for infants' ability to segment fluent speech into words. For infants learning a stressed timed language like English, Dutch or German, evidence was found for the use of the predominant trochaic stress pattern of the language as a cue to word boundaries [4]; [5]; [6].

Indeed, American 7.5-month-olds are able to segment bisyllabic trochaic words from fluent speech while they fail with iambic words. Thus, recognizing the prevailing stress pattern in one's native language is crucial for the development of word segmentation routines suggesting that this developmental step has to precede the ability to segment words. Accordingly, it has been proposed that the trochaic bias observed in English, Dutch and German would not result from the acquisition of the predominant lexical stress pattern of these languages, but from the acquisition of the basic rhythmic unit of these languages [7]. This hypothesis also predicts that the emergence of the trochaic bias is not innate, but language-specific.

Our experiments focus on the determination of whether and when a trochaic bias effect can be observed in German- and French-learning infants. German is a stress-based language, with German words being predominantly trochaic. On the other hand, French is a syllable-based language, in which there is little if any accentuation at the lexical level; if anything, final syllables will be lengthened in French. Moreover, the rhythmic unit of German is the trochaic unit, while the rhythmic unit of French is the syllable. Therefore, if the trochaic bias reflects some acquisition of the rhythmic properties of the native language, a trochaic bias should only be observed for German-infants and not for French-learning ones. Given the results in [3], Experiment 1 (a) and (b) tests this hypothesis with German and French 6-month-olds.

2. METHODOLOGY

2.1. Experiment 1.

2.1.1. Stimuli

The CVCV sequence *GA-BA* either stressed on the first or on the second syllable served as stimulus for this experiment. Sixteen tokens of each stress pattern were recorded by a female German native speaker. After recording, the stimuli were digitized and saved as computer files. An acoustical analysis of durational and pitch features was conducted with the speech editing and analyzing software PRAAT to verify that the stimuli had the intended stress pattern (see Table 1). For each stress pattern, 6 speech files were created containing various tokens in different orders. The speech files were 18.00 to 18.51 s long.

2.1.2. Procedure

The experiment was run using the headturn preference paradigm. During the experimental session, the infant is seated on the lap of a caregiver in the center of a test booth. Inside the booth, three lamps are fixated: a green one on the center wall, and red ones on each side wall. Directly above the green lamp on the center wall is a hole for the lens of a video-camera. Behind the side walls, two loudspeakers are mounted at the same height as the red lamps.

Table 1. Acoustic properties of the Strong-week and week-Strong stimuli

	Duration (ms)		Pitch (Hz)	
	Syll. 1	Syll. 2	Syll.1	Syll. 2
GA-ba (S-w)	283	308	195	163
ga-BA (w-S)	172	431	186	183

Each experimental trial is started by the blinking of the green center lamp. When the infant orients to the green lamp, this lamp goes out and one of the red lamps on a side wall starts to blink. When the infant turns her head towards the red lamp, the speech stimulus is presented from the loudspeaker on the same side as the blinking red lamp. The trial ends when the infant turns her head away for more than 2 s, or when the end of the speech file is reached. If the child turns away for less than 2 s, the presentation of the speech file is continued but the time spent looking away is not included in the total orientation time. The presentation of the first two speech files – one of the trochaic and one of the iambic pattern – served as warming-up trials and were not included into the data analysis. The remaining 10 trials (5 trochaic and 5 iambic files) were presented in random order. The exact duration of each experimental session depended on the infant's behavior and varied approximately between 3 and 5 minutes.

2.1.3. Participants

Twenty-four German-learning 6-month-olds (12 girls and 12 boys) were tested in Experiment 1(a) in Posdam. All infants were born full-term and had parents with German as their native language who only talked to their infant in German.

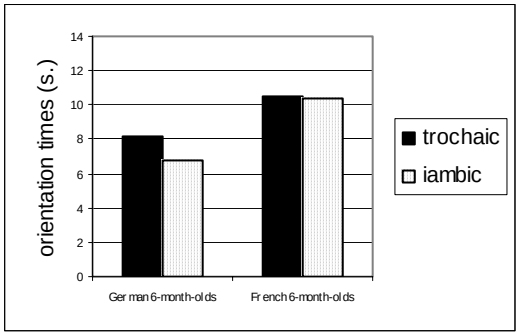
Twenty-four French-learning 6-month-olds (11 girls and 13 boys) were tested in Experiment 1(b) in Paris. All infants were born full-term and had

parents with French as their native language who only talked to their infant in French.

2.1.4. Results

Our results show that German 6-month-olds already prefer to orient to trochaic as compared to iambic bisyllables (c.f., Fig. 1, left). On average, infants oriented to the trochaic sequences for 8.14 s and to the iambic sequences for 6.81 s. This difference was significant, $t(23) = 2.26$, $p = 0.03$. Nineteen of the infants had longer orientation times to the trochaic than to the iambic sequences. French-learning infants oriented to the trochaic sequences for 10.47 s while they oriented to the iambic sequences for 10.39 s. This difference was not significant, $t(23) = .22$, $p = 0.83$ (c.f., Fig. 1, right). Moreover, only 11 infants had longer orientation times to the trochaic sequences.

Figure 1. Mean orientation times for trochaic and iambic bisyllabic sequences in German (left) and French (right) 6-month-olds.



Since the trochaic pattern is predominant for German bisyllabic words, our results suggest a preference for the language predominant pattern. Alternatively, it might reflect the acquisition of the rhythmic unit (trochaic unit) of this language. This knowledge appears to be acquired by the age of 6 months, and is thus available at the onset of word segmentation procedures in German. On the other hand, the lack of a preference in French 6-month-olds is compatible with the fact that French words are only stressed when they appear phrase finally and that the rhythmic unit of French is the syllable.

Two questions follow from these results:
(1) If knowledge about the predominant stress pattern of the native language is already established in German 6-month-olds, the starting point for the development of this knowledge has to be searched at an even younger age. Accordingly, a group of German-learning 4-month-olds was tested in Experiment 2, using the same procedure and the same stimuli

(2) If French-learning infants do not show a preference between trochaic and iambic sequences because stress is not a salient cue for speech segmentation in French, the lack of a preference should not be due to infants' non-discrimination of the stimuli. Experiment 3 is designed to test French-learning 6-month-olds' capacities to discriminate the stimuli used in Experiment 1(b).

2.2. Experiment 2.

2.2.1. Participants

Twenty-four infants around 4 months of age (15 girls and 9 boys) participated in the experiment. The criteria for selecting the participants were the same as in Experiment 1.

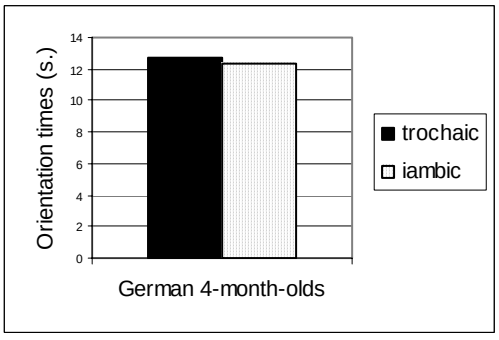
2.2.2. Stimuli and Procedure

The same stimuli as in Experiment 1 were used and the procedure were identical to Experiment 1 with minor adaptations to younger infants in the positions of the red lamps and the loudspeakers.

2.2.3. Results

On average, German 4-month-olds oriented to the trochaic sequences for 12.72 s and to the iambic sequences for 12.38 s (c.f., Fig. 2). This difference was not significant, $t(23) = 0.57$, $p > 0.05$. Fifteen infants had longer orientation times to the trochaic sequences than to the iambic ones.
German 4-month-olds did not show a significant preference for the trochaic sequences. This suggests that the preference for trochaic sequences emerges during development, between 4 and 6 months of age for German.

Figure 2. Mean orientation times for trochaic and iambic sequences in German 4-month-olds.



2.3. Experiment 3.

In this experiment, we tested the capacities of French-learning infants to discrimate trochaic vs. iambic sequences used in Experiment 1(b).

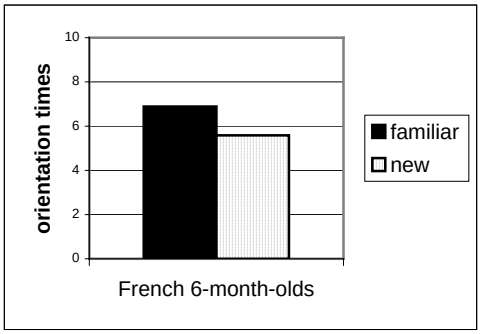
2.3.1. Participants and procedure

Sixteen infants around 6 months of age (6 girls and 10 boys) participated in the experiment. The criteria for selecting the participants were the same as in Experiment 1. In this experiment, infants were first habituated for at least 60 seconds with sequences of one type (trochaic or iambic), and then tested with 6 trials of trochaic sequences and 6 trials of iambic sequences. If infants discriminate between trochaic and iambic sequences, they should orient differently in the test phase to sequences with the familiarized versus new stress pattern.

2.3.2. Results

On average, infants had longer orientation times in the trials with the familiarized pattern (M = 6.89 s) than to the trials with the new pattern (M = 5.59 s), $t(15) = 2.82$, $p = .013$ (c.f., Fig. 3). This result establishes that French-learning 6-month-olds can discriminate trochaic and iambic sequences, and thus shows that their failure in Experiment 1(b) was not due to a lack of discrimination.

Figure 3. Mean orientation times for the familiarized versus new stress pattern in French 6-month-olds.



3. General Discussion

The present study explored German- and French-learning infants' perception of stress pattern at the level of bisyllabic words. Infants were presented with pseudowords with the predominant pattern of German words (trochaic) or the opposite pattern (iambic); as mentioned earlier, lexical stress is only marked when the word appears in specific positions in French.

Our results first show an emergence of the preference for trochaic over iambic words between 4 and 6 months of age in German-learning infants (Exp. 1(a) and 2). Given that it has been established that word segmentation procedures emerge between 6 and 7.5 months of age, this result suggests that preference for trochaic sequences emerge prior to the onset of segmentation abilities, and thus supports the proposal that it reflects infants' acquisition of the rhythmic unit of their native language.

In this context, we predicted that French-learning 6-month-olds would not show such a preference given that the rhythmic unit of their language is the syllable. This prediction is supported by the results of Exp. 1(b). Finally, Exp. 3 establishes that the absence of a preference at 6 months in French infants is not due to a non-discrimination of the two stress patterns.

Overall the present study illustrates the language-specific acquisition of prosodic properties during the first half-year of life.

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