*Faster Orientation Latencies Toward Native Language in Two-Month-Old Infants**

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KEY WORDS

infants

language

prosody

reaction times

speech perception

ABSTRACT

There is increasing evidence that infants can discriminate native and non-native speech from an early age. Prosody may be essential to this ability. In this paper, we assess the amount of linguistic information needed by 2-month-old infants to recognize whether or not a sentence belongs to their native language. We conducted a cross-linguistic study of French and American 2-month-old infants, measuring the latency of the first ocular saccade toward a loudspeaker playing short French and English utterances. The results indicated a significant interaction between the infants' nationality and the language of the stimuli. Infants oriented faster to their native language, even when the utterances were short (1.2 s mean). However, eliminating the prosodic organization (scrambled words condition) of the sentences, neutralized the effect. The results confirm that prosody plays a predominant role when young infants process continuous speech, and that short utterances are sufficient to recognize a language as long as prosodic information is present and coherent across the utterance.

INTRODUCTION

During the last three decades, research has demonstrated that infants' linguistic capacities are rich and complex. However, the experimental paradigms used have not allowed researchers to explore the speed of infants' linguistic processes. For example, it has been

* Acknowledgments: This study was supported by a NIMH Grant 4361–05 to Dr. Mary Rothbart and the James S. McDonnell Foundation grant to the Center for the Cognitive Neuroscience of Attention at the University of Oregon. G.D. was supported by I.N.S.E.R.M., the Fyssen Foundation, la Société de Médecine Périnatale, la Fondation pour la Recherche Médicale, Capital humain et mobilité (CEE) N° ERBCHRXCT9Z0031. We thank M. Posner, M. Rothbart, S. Dehaene, J. Mehler, A. Christophe, and J. Bertoncini for their comments and Laure Amiot, and Lisa Thomas-Thrapp for their help.

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demonstrated that neonates are able to recognize their native language (Mehler, Jusczyk, Lambertz, Halsted, Bertoncini, & Amiel-Tison, 1988; Moon, Cooper, & Fifer, 1993). This early capacity is presumably based on the prosodic characteristics of the native language because neonates demonstrate the same behavior when the sentences are low-passed filtered in order to remove all the language characteristics except the prosodic information (Mehler et al., 1988). In these studies, long sentences (e.g., 17 seconds in the Mehler et al. (1988) study) have been presented to the subjects for several minutes before eliciting a change in behavior related to language discrimination. This does not necessarily mean that language processing is slow at this age but rather that experimental paradigms in infants are classically designed to study discrimination capacities but not processing speed. Assessing how quickly infants recognize their native language would provide new information about their early language representations. Furthermore, it has been argued that early attention to the prosodic structure of speech might bootstrap grammatical and lexical learning by helping infants segment the speech stream and by linking together related terms (Gleitman & Wanner, 1982; Christophe, 1993). Determining which prosodic units are accessible to infants in continuous speech to characterize their native language would provide new insights into their language strategies. We propose in this paper that eye orientation latencies could be used to assess speed of speech processing in infants.

Although pressing a response key does not belong to the infant's behavior repertoire, orientation behavior toward auditory or visual lateralized stimuli has been demonstrated from birth (Field, Muir, Pilon, Sinclair, & Dodwell, 1980). As with adults, infants' orientation latencies do not depend solely on stimulus localization procedures but are modulated by interfering cerebral processes. Consequently, it has been suggested that eye orientation latencies could reflect both processes necessary for locating targets and processes involved in analyzing them (Canfield, Smith, Brezsnyak, & Snow, 1997). Indeed, several studies in infant visual research have shown that eye orientation latencies are modulated by attention, expectation, or previous knowledge of the stimulus. For example, four-month-olds' orientation latencies to lateralized stimuli decrease when the nature of a central cue predicts the side of a target (Johnson, Posner, & Rothbart, 1991). Four-month-olds also orient faster to their mother's face than to an unfamiliar face (de Schonen, Deruelle, Mancini, & Pascallis, 1993). Although auditory orientation has been studied less than orientation to visual stimuli, several studies of adults and of animals have underscored the similarities between visual and auditory orientation processing (Russo & Bruce, 1994; Farah, Wong, Monheit, & Morrow, 1989). Furthermore, Spence and Driver (1994) have demonstrated that in adult subjects auditory orienting is similar to visual orienting in that it is not always automatic but can be modulated by attention. Newborns are able to orient to auditory stimuli (Field et al., 1980) and head and eye orientation to auditory stimuli has been used to demonstrate discrimination capacities (Kuhl, 1985). The dependent variables in these experiments were either the number of correct looks or the fixation time to a lateralized loudspeaker. The orientation latencies were not measured. By analogy with the results obtained in experimental paradigms using eye orientation to visual stimuli, we expect that orientation latencies to acoustic stimuli should also reflect information processing and be affected by infants' stimulus representations.

In the following experiments we investigate infants' orientation latencies to speech stimuli. Latency differences between conditions may reflect differences in speech processes and give clues about infants' speech representations. It is now well demonstrated that infants are able to discriminate native and non-native languages (Mehler et al., 1988; Moon et al., 1993; Hesketh, Christophe, & Dehaene-Lambertz, 1997). This suggests that by two months, infants already represent their native language in a way that allows them to classify sentences as familiar or unfamiliar. Because orientation latencies are accelerated by expectation of a familiar visual stimulus (DeSchonen et al., 1993; Haith, Hazan, & Goodman, 1988), we predict that familiarity with speech should also accelerate orientation latencies. We will therefore compare infants' orientation latencies to native and non-native language. In addition, by shortening or impoverishing the speech signal, we will try to determine the minimal information necessary to induce this effect.

EXPERIMENT 1

Several experiments have demonstrated that during the first six months of life, infants are able to discriminate between languages that differ in prosodic structure, such as French and Russian, English and Italian (Mehler et al., 1988), English and Spanish (Moon et al., 1993) or English and Japanese (Nazzi, Bertoncini, & Mehler, in press; Hesketh et al., 1997). However, when the two languages are similar in their prosodic properties (e.g., Dutch and English), young babies seem to include them in the same set and do not discriminate between them (Christophe & Morton, in press). In order to study if familiarity with a language could affect orientation latencies, we chose two languages belonging to two different rhythmic families, French and English. Linguists classify French as a syllable-timed language and English as a stress-timed language: In French, unlike English, all the syllables are fully realized. The accented syllable is always the word's last syllable and the differences in duration, energy, and pitch, are small between accented and nonaccented syllables. Finally, there is a high proportion of open to closed syllables in French (Dauer, 1983; Fletcher, 1991; Fant, Kruckenberg, & Nord, 1991). These parameters give an impression of syllable regularity for French, that can be distinguished from the stress-timed rhythmic pattern of English (Abercrombie, 1967). Mehler, Dupoux, Nazzi, and Dehaene-Lambertz (1996) have suggested that young infants may use these broad rhythmic classes to classify speech input. A second reason for this choice is that we were able to test American-English and French babies allowing us to examine how linguistic background could affect orientation latencies to the same stimuli.

If orientation latencies depend only on sound localization processing, French and American infants should orient similarly to French and English sentences. If speech analysis processes interact with orientation processes, orientation latencies could differ for the two languages: One possible interaction is that either English or French may have different attractive properties for infants because of their rhythmic structure, which could induce both French and American babies to orient faster to one of the languages. Another possibility is that language familiarity could induce faster orientation latencies. In this case, we predict an interaction between the language of the sentences and the nationality of the infants.

Another aim of these studies was to assess the role of prosody in infants' speech processing. The first experiment included sentences that were low-passed filtered, which greatly reduces most properties of speech but retains the prosodic properties. If infants focus exclusively on prosodic properties in continuous speech, then we would expect them to process low-passed filtered speech the same as unfiltered speech.

Method

Subjects. Fourteen 2-month-old subjects were recruited from monolingual American-English speaking parents living in the Eugene-Springfield area of Oregon. The data from two additional subjects were not recorded due to experimenter error. Nine other subjects were rejected because they listened to less than half of the sentences because of excessive crying and/or sleepiness. The 14 subjects (9 girls, 5 boys) had a mean age of 68 days (56 to 75 days).

A second group of 12 two-month-old French infants (4 girls, 8 boys), living in the Paris area, was also tested. They were from monolingual French speaking families, with a mean age of 66 days (57 to 73 days). Also tested but excluded from further analysis were five subjects who did not pass half of the trials because of excessive crying and/or sleepiness, two who were seated on their mother's lap because they started crying as soon as they were seated in the baby chair and one whose test data was corrupted by video recording problems.

All subjects were full term, without any medical complications during birth or the first months of life. Full informed consent was obtained from the parents.

Stimuli. A modified version of the tale *The Three Little Pigs* was written in French and English. All the sentences were adjusted so that they were short and had the same simple grammatical structure in French and English. The number of syllables was balanced as much as possible in each syntactic constituent. Word repetitions across sentences (e.g., pig, wolf, house) were avoided by using synonyms.

A bilingual woman was recorded reading the two versions in French and English. She was a professional translator from a bilingual French-American family. She used the two languages daily. She was instructed to read the story as if reading to a child, with a *child-directed speech* intonation. Five native speakers of each language listened to the stimuli in their language. All English speaking adults (four American and one British) thought that she was a native American-English speaker and all French speakers judged that she was a native French speaker. All listeners spontaneously noticed that she was speaking to children because of her child-directed speech intonation.

Sixty-four pairs of sentences were extracted from this recording (Appendix A). Each sentence corresponded to a phonological utterance in Nespor and Vogel's classification (1986)—that is, it could have been produced in isolation. The number of syllables per sentence was very close in the two languages: 11.1 in English (9 to 13 syllables) and 11.0 in French (10 to 12 syllables), $F(1,126)=1.19, p=.28$.[1] However, the mean duration of the sentences was significantly different, $F(1,126)=20.21, p<.001$. The mean length was 2390 ms in French (1618 to 3875 ms) and 2777 ms in English (2012 to 4043 ms). The syllabic rate was consequently different in French and English (286 vs. 246 syll./min, $F(1,126)=24.33, p<.001$. These differences may either be an idiosyncrasy of the speaker or they may reflect differential properties of the languages under study. For instance, monosyllabic words are more frequent in English than in French (e.g., *pig* for *cochon*; *home* for *maison*). In order to maintain similar grammatical structure between the two languages while using the same number of syllables, it was necessary to use more words in the English than in the French sentences (8.6 vs. 8.1, $F(1,126)=6.36, p=.013$). This difference in

[1] Although linguists prefer to describe English rhythmic structure in feet rather than in syllables, we have no evidence that infants' perception supports this view. Accordingly, each syllable was counted for the purpose of matching sentences across languages.

word number could account for the slower speech rate in English since the intonation of child-directed speech exaggerates the duration of words.

The 64 pairs of sentences were run through a digitized low-pass filter which removed all frequencies above 400 Hz (Butterworth filter, cut-off frequency=400 Hz, filter order=4).[2] Hence, each sentence was available in four conditions: English, filtered English, French, and filtered French.

The sentences were presented in a semirandom order. Each condition appeared twice in a block of eight sentences, and all possible transitions between conditions occurred once within every 16 consecutive sentences. Babies never heard the same sentence twice: That is, if a baby heard a sentence in the French normal condition, he/she did not hear the matched English sentence nor the filtered French or English version of this sentence. Four sequences of 64 sentences respecting these constraints were constructed.

For the American group, the four sequences of sentences were recorded on four cassettes, with an interstimulus interval of nine seconds. The duration of a cassette was about 15 mins. The French group benefited from a technical improvement: The sentences were recorded on the hard drive of a PC computer and were played directly by the computer.

Procedure

The infants sat in a baby-chair 80 cm from a computer monitor. Two speakers were at 33 degrees to the left and the right of the baby and were covered with the same colorful picture of a woman. Before the beginning of the experiment, the experimenter showed both pictures to the baby. A video camera placed above and set back from the monitor recorded eye movements. A second camera behind the subject recorded the computer monitor. This image and a timer were superimposed in a corner of the video screen to allow off-line coding. The experimenter and the parents were separated from the baby by a wooden partition and checked the experimental run through a video control monitor.

For each baby of the American group, a cassette was randomly chosen from among the four cassettes. During the experiment, the cassette was played without interruption on a cassette recorder. Before each trial, the attention of the infants was first brought to the center using colorful moving dots that formed a spiral on the computer monitor. Just before each sentence began, the computer switched on the sound channel for one of the speakers. The sentences were semirandomly presented to the right and the left of the infant. Each condition was presented once on the left and once on the right in blocks of eight sentences. When a sentence began, the experimenter pressed a key to turn off the spiral.[3] Then eight seconds elapsed before the next spiral reappeared on the central monitor.

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[2] In order to assure that the language of low-pass filtered sentences was still identifiable, ten French and ten American-English adults were tested in a forced choice language recognition task. They correctly identified the language of the filtered sentences in 65.5 % of the trials. This performance is significantly different from a random choice, $t = 6.9, p < .001$ (Dehaene-Lambertz, 1995), and similar to the results of other studies using filtered speech in adults (Maidment, 1983; Ohala & Gilbert, 1979).

[3] The experimenter's average reaction time was 268 ms (285 ms and 265 ms for normal English and French sentences, 256 and 267 ms for filtered English and French sentences). An ANOVA performed on the reaction times of all 869 trials with Language (French or English) and Filtering (filtered or normal) as between-trials factors showed no significant main effect or interaction.

The side of presentation of the sound and the reappearance of the spiral after eight seconds were controlled by an Apple IIe computer. Eye-orienting behavior was recorded during the entire session and coded off-line.

For each subject of the French group, a sequence of stimuli was randomly chosen from among the four possibilities. The sentences were played by a PC computer through a 16-bit sound card. The procedure was similar to the one described above except that the experimenter now waited until the infant oriented back to the center before pressing a key to begin a new trial. With the previous setting, events were entirely determined by the timing of the cassette recording and hence a number of trials were lost because the infant had not been staring at the central attractor when the sound began.[4] With the new setting, central fixation was ensured on each trial. Another difference was that the computer itself turned off the central spiral just before the beginning of the speech stimulus. With the previous setting, the spiral remained on for a short period while the sound was playing, since its offset was determined by the experimenter's reaction to the sound.

Coding. A timer and the computer monitor image displaying the spiral were superimposed on the video tape in order to code reaction times. Coding the American infants' reaction times required one more step than the procedure with the French infants because the coder first had to locate the frame where the sound began by playing the video frame-by-frame with the sound. For the French group, the fading of the central spiral was controlled by the computer and always occurred 60 ms before the beginning of the sound. Therefore, the frame following the disappearance of the spiral was used as the beginning of the trial.

All reaction time coding was performed with the sound track muted. The coder was thus blind to the location and contents of each stimulus. A trial was rejected if the infant was not front-centered at the beginning of the trial or cried or yawned during the trial or if the eyes were not clearly visible. For the valid trials, the first eye movement during each eight-second trial was coded: The beginning of a look was defined as the first frame on which the eyes moved to one side. Reaction time was therefore measured as the difference in timing between the beginning of the trial and the beginning of the first look.

Trials with reaction times over 8 s or under 200 ms were rejected. The lower limit of 200 ms was probably too conservative for 2-month-old subjects but was used because it is the standard limit chosen in ocular orientation paradigms with infants in the literature.[5]

In order to verify the reliability of eye movement coding, babies were double scored. The coders' interagreement was .99 on whether a trial was valid or not, .96 on whether a look was present during the trial or not and .93 on the direction of the first look. For orientation latency scoring, coders' disagreement was defined as a difference of at least three frames in the scoring of the onset of eye movement. The coders interagreement was 88.6% and the cases of disagreement were re-examined until a mutual agreement was achieved.

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4 On average, five trials per subject (0 to 17) were lost because the infant was not front-centered when speech began.

5 In adults, the fastest reaction times to visual stimuli located at more than 4° of the central fixation are around 180–200 ms (Saslow, 1967). Infants are slower than adults and there is an acceleration during development. In a visual orientation task, the mean reaction time is 760 ms at 2 months and 447 ms at 4 months (Johnson, 1994). Therefore, orientation latencies below 200 ms are usually classed as anticipations in infants.

TABLE 1

Experiment 1: Percentage of correct looks

Stimuli	*American infants*	*one tail t-test for a significant deviation from 50% (d.f.= 13)*	*French infants*	*one tail t-test for a significant deviation from 50% (d.f.= 11)*
English	61.0 %	<.01	66.1 %	<.01
French	64.3 %	<.01	64.2 %	<.01
Filtered English	54.9 %	.12	59.6 %	.01
Filtered French	57.6 %	.03	56.5 %	.04

Results

The average number of valid trials was 55.5 for American babies and 59.8 for French babies, $t(26)=1.61, p=.12$.

Analyses of hits and errors rates. For each valid trial, three responses were possible: A correct look toward the speaker playing the sentences (53.9%), a contra-lateral orientation (35.1%), or an absence of orientation (11.1%). An ANOVA performed on the percentage of absence of orientation with Nationality (French vs. American) as a between-subjects factor and Language (French and English) and Filtering (filtered vs. normal) as within-subject factors showed no main effect nor interaction. On the remaining trials where an orientation response was observed, infants oriented to the correct speaker more often than chance alone would predict (correct orientation: 60.26%; one-tailed t-test for a significant deviation from 50%, $t(25\ d.f.)=6.09, p<.001$). An ANOVA was performed on the percentages of correct looks with the same factors as above. The only significant effect or interaction was a main effect of filtering, $F(1,24)=4.52, p=.044$, due to an increase in the number of errors for the filtered stimuli. Nevertheless, the percentage of correct looks was significantly greater than chance for both the filtered condition (correct orientation: 56.3%; $t(25\ d.f.)=3.09, p=.002$) and the normal condition (correct orientation: 63.7%; $t(25\ d.f.)=5.72, p<.001$) (Table 1).

Analyses of reaction time. In subsequent analyses, only correct responses were considered. The average number of correct responses was 29.6 for American babies and 28.5 for French babies, $t(24)<1$. For each subject, the average reaction time in each of the four conditions (English, filtered English, French, and filtered French) was calculated. Then an analysis of variance was performed with the factors defined as above.[6]

There was a main effect of nationality, $F(1,24)=11.0, p=.003$. French infants oriented faster than American infants (1662 ms vs. 2292 ms). There was a nonsignificant tendency for babies to orient slower toward filtered speech, $F(1,24)=3.6, p=.07$, and there was no effect of language, $F(1,24)=2.6, p=.12$. The main result of interest, the Nationality ×

[6] Because the American-English and French groups were not fully comparable in gender make up (35.7% males in the American group vs. 66.7% in the French group), another ANOVA was performed with sex as an additional between-subject factor. There were no significant main effect of sex, nor any interaction between this factor and any other factors in the analysis.

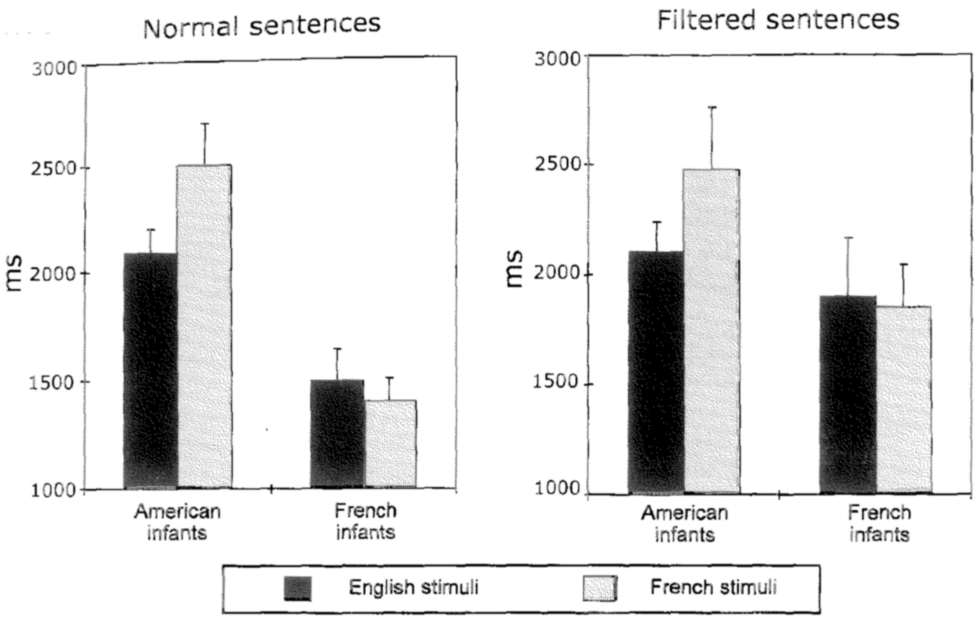

Figure 1

Orientation latency toward normal and filtered sentences in 2-month-old French and American infants. Bars represent one standard deviation of the mean.

Language interaction was significant, $F(1,24)=4.33$, $p=.048$. As shown by Figure 1, American infants oriented faster to English sentences than to French sentences (2096 ms vs. 2487 ms, 391 ms effect, $t(13)=2.66$, $p=.019$), while French infants showed a nonsignificant trend toward orienting faster to French than to English sentences (1698 vs. 1627 ms, 72 ms effect, $t(11)<1$). Finally, the Nationality × Filtering interaction was significant, $F(1,24)=4.5$, $p=.045$. French infants oriented more slowly to filtered than to normal stimuli (1873 ms vs. 1452 ms, $t(11)=3.1$, $p=.011$), whereas American infants oriented equally fast in the two conditions (2295 ms vs. 2289 ms, $t(13)<1$). All other two- or three-way interactions were nonsignificant.

Discussion

In this experiment, 2-month-old American and French infants displayed different behavior toward the same stimuli. American infants oriented faster to English sentences than to French sentences while French infants showed a nonsignificant trend in the reverse direction. These results demonstrated first that orientation to auditory stimuli is modulated by the nature of the stimulus and that stimulus presentation triggers not only localization processes but also speech analysis processes. Therefore, this method appears to be suitable for studying speech representation in infants by characterizing the features that speed up (or slowdown) eye orientation.

The interaction between infants' nationality and the language of the stimuli indicates that the native/non-native language status of the sentences had an influence on orienting behavior. Had orienting latencies depended only on acoustical differences, such as length or speech rate, French and American infants would have exhibited the same behavior. The influence of the linguistic environment on infants' behavior agrees with previous results obtained by Mehler et al. (1988) on language discrimination using a different method. In their experiments, infants were exposed to several minutes of one language before exhibiting a behavioral change. The results of the present experiment indicate that infants react to their own language on the basis of less than three seconds of continuous speech signal. Furthermore, 2-month-old infants may respond differentially to sentences before the completion of the sentences. Their mean reaction time was faster than the mean duration of the sentences. On average, babies oriented after hearing about 75% of the sentences of their native language, suggesting that infants may be sensitive to the characteristics of units smaller than sentences.

Mehler et al. (1988) argued that language discrimination is based on the prosodic structure of languages because they found the same results when speech stimuli were low-pass filtered. Low-pass filtering preserves prosodic information while eliminating all or almost all of the segmental information. In the present experiment as illustrated by Figure 1 and by the nonsignificant Filtering × Language interaction, subjects behaved similarly for filtered and normal sentences. However, statistical evidence was weaker for filtered speech than for normal speech. Posthoc analyses showed a significant Nationality × Language interaction (253 ms effect, $F(1,24)=4.81$, $p=.038$) for normal speech but not for filtered speech (210 ms effect, $F(1,24)<1$). This can be tentatively related to the acoustical properties of filtered stimuli. Like Morrongiello and Clifton (1984), who observed that young infants experience difficulties in localizing low-frequency sounds, we found more errors with filtered stimuli. Because of the higher error rates, the average reaction time was calculated on fewer trials in the filtered condition than in the normal condition which may account for the higher variance and weaker statistics in this condition.

In addition to the effect of linguistic background, two other variables affected infants' orientation latencies. First, while American infants oriented significantly faster toward their native language, French infants had only a trend toward orienting faster to French sentences. This asymmetry in the results could be interpreted as a combination of a main effect of linguistic background and of a trend toward faster orientation to English sentences. The two effects were in the same direction for American infants but in the opposite direction for French infants. This bias for English sentences could be due to the construction of the experimental material. For example, the length and the syllabic rate were different in the two sets of sentences (although the two distributions showed considerable overlap). The child-directed speech intonation pattern might also be more pronounced in English for cultural reasons (Fernald, Taeschner, Dunn, Papousek, de Boysson-Bardies, & Fukui, 1989) or the prosodic structure of the two languages might be responsible for the effect. In the general discussion we will address the nature of the bias by considering whether it is related to an idiosyncrasy of the speaker or to the structure of these two languages. Despite this bias the main finding is clear: American and French babies oriented differently toward identical stimuli.

Another effect in the present experiment is the unexpected consequence of the change of procedures between the two groups. For the American infants, the central visual attractor remained on for the first 300 milliseconds after the onset of the sentences but it was turned off immediately for French infants. As a result, French babies oriented significantly faster than American babies. This effect is compatible with the studies showing that 2–3 month-old infants experience difficulties in disengaging gaze from a central visual stimulus to orient to a lateralized stimulus (Johnson et al., 1991). The difference in procedure could also explain the nationality by filtering interaction since French infants, but not American infants, were slower in the filtered condition than in the normal condition. Despite equal objective intensity, low-pass filtered stimuli are perceived as being weaker than normal stimuli. Thus the onset of the filtered stimuli was probably less perceptible than the onset of the normal sentences, increasing the subjects' response latencies to the former. American infants did not exhibit a similar effect perhaps because their orientation time was already slowed by the persistence of the central spiral during the first hundred milliseconds of speech.

In summary, Experiment 1 indicated that it is possible to obtain temporal measures in young infants and suggested that language familiarity can be determined on the basis of hearing a single sentence or less. In order to study the minimal amount of information 2-month-olds need to react to their native language, we conducted a second experiment in which we reduced the duration of the utterances and the size of the prosodic units in the stimuli. We also corrected some inconsistencies involved in Experiment 1. The same procedure was used in both groups of subjects. Also gender proportion, which was moderately biased in Experiment 1 (36% males in the American group vs. 67% in the French group) was better balanced in Experiment 2.

EXPERIMENT 2

In the first experiment we found evidence that 2-month-olds react differently to single sentences of different languages. The aim of the second experiment was to determine whether this effect could be produced with smaller amounts of speech input. Two units have been considered—intonational phrases and words. Intonational phrases are intonation contours to which a pause can be added at the beginning and at the end without modifying the coherence of the contour. Thus for the first condition of Experiment 2, the sentences of Experiment 1 were cut at a major syntactic boundary that was marked in the prosody. It was expected that infants would still react differently to the two languages in this condition confirming that their native language representation is based on a smaller prosodic unit than sentences.

The second condition was the scrambled words condition. Multisyllabic words or phrases were taken from the original stimuli and spliced together in an improper order so that the global prosodic structure was eliminated while maintaining the same word-level information. If infants are sensitive to the rhythmic properties of their language, then several successive multisyllabic words or phrases should provide enough information to discriminate the syllable-timed rhythmic pattern of French and the stress-timed rhythmic pattern of English. Indeed, Jusczyk, Friederici, Wessels, Svenkerud, and Jusczyk (1993) have shown that six-month-olds can use the prosodic structure of the words to recognize their native language. However, since young infants may be less capable of processing small prosodic units than older infants (Jusczyk et al., 1992), 2-month-old babies might not have access to word-level prosodic structure. The aim of Experiment 2 was to test whether 2-month-olds are sensitive to the intrinsic rhythmic properties that distinguish French from English and to examine the effect of eliminating the global prosodic structure on processing smaller units. If 2-month-olds process speech using global prosodic structure, then they may be more likely to distinguish the two languages in the intonational phrases condition than in the scrambled words condition.

Method

Subjects. Eighteen 2-month-old subjects were recruited from monolingual American-English speaking parents living in the Eugene-Springfield area of Oregon. Ten additional subjects were rejected because they listened to less than half of the stimuli due to excessive crying and/or sleepiness. Two more were rejected for technical problems. Among the 18 subjects, ten were female and eight were male with a mean age of 64 days (60 to 72 days).

A second group consisted of 18 two-month-old French infants (11 girls, 7 boys) living in the Paris area. They were from monolingual French speaking families, with a mean age of 68 days (61 to 76 days). Eleven more subjects were tested and ten were excluded due to excessive crying and/or sleepiness. The last one was rejected because he had no correct orientation in one of the conditions.

All subjects were full term, without any medical complications during birth and the first months of life. Full informed consent was obtained from the parents.

Stimuli. The sentences from the previous experiment were digitized and manipulated to obtain two experimental conditions for each language. Each condition had the same number of syllables on average. In the *intonational phrase* condition, the sentences were cut at syntactic boundaries that were marked prosodically. Thus, the sentences were cut either between two clauses or before an adverbial phrase. The resulting grammatical structure was very simple, NP-VP or NP-VP-NP for the majority of the stimuli. The prosodic structure consisted of one or two intonational phrases. In the scrambled words condition, multisyllabic words (e.g., *attention*) or phrases (e.g., *old man*) were extracted from the original sentences. The words were cut at zero crossing points in order to avoid clicking sounds. Because of the characteristics of child-directed speech, each selected word or phrase was perfectly recognizable in isolation. A new utterance was obtained by pasting two or three of these multisyllabic strings, separated by 150 ms of silence, in order to obtain a total of four to seven syllables for each utterance, similar to the intonational phrases. To eliminate global coherence, the words were grouped in such a way that a word extracted from the beginning of a sentence was placed at the end of the new utterance and vice versa. For example, the sentence *and he lay down to digest his dinner/et il se couche pour digérer son repas* was used to create two intonational phrases (*and he lay down* and *to digest his dinner*, *et il se couche* and *pour digérer son repas*), and one scrambled words utterance (*dinner digest lay down*, *repas digérer se couche*).

In each condition, 64 pairs of utterances were constructed (Appendix B and C). The number of syllables was similar in the two conditions (5.6 syllables) but the duration was different by construction. The mean intonational phrase duration was 1178 ms, shorter than the mean scrambled words duration (1444 ms, $F(1,252)=46.27$, $p<.001$). Because the stimuli were extracted from the sentences of the previous experiment, a slight difference in duration between French and English samples persisted. For the intonational phrase condition, the mean duration was 1230 ms in English (783 to 1938 ms) and 1126 ms in French (573 to 2219 ms) (104 ms, $F(1,126)=4.06$, $p=.046$). For the scrambled words condition, the mean duration was 1494 ms in English (739 to 2376 ms) and 1395 in French (737 to 1975 ms) (99 ms, $F(1,126)=2.83$, $p=.095$). Similar differences were found in syllabic rates (intonational phrases: 279 in English vs. 312 syll./min in French—$F(1,126)=12.4$, $p<.001$; and scrambled words: 230 in English vs. 253 syll./min in French—$F(1,126)=8.88$, $p=.003$).

These utterances were presented in a semirandom order with the same constraints as in Experiment 1.

In order to gauge the difficulty of the two conditions, ten French and ten American-English adults were tested in a forced choice language recognition task. The stimuli were low-pass filtered above 400 Hz to force the adults to use only the prosodic information. Adults correctly identified the language of the filtered utterances in 63% of the intonational phrases ($t=11.1$, $p<.001$) and 62% of the scrambled words ($t=12.0$, $p<.001$), indicating that prosodic information in the two conditions was sufficient to discriminate the two languages.

Procedure. The same experimental and coding procedures were used for the French and the American groups. They were similar to the procedures used in Experiment 1 for the French group: For both groups, the stimuli were presented through a 16-bit sound card using a PC computer, so that the spiral never overlapped with the speech. The infants sat on a baby chair and had no contact with their parents during the experiment. The coders interagreement was similar to the previous experiment: .99 on the valid trials, .95 on the presence of a look during the trial, .93 on the direction of the first look, and .85 on the scoring of reaction times.

Results

The average number of valid trials was 54.0 for American babies and 48.8 for French babies, $t(34)=1.17$, n.s.

Analyses of hits and errors rates. On average 10.1% of trials resulted in no looks and an ANOVA performed on this measure with Nationality (French vs. American) as a between-subjects factor, Language (French or English), and Condition (intonational phrase or scrambled words) as within-subject factors showed no main effect or interaction. On the trials with an orientation response, infants oriented to the correct speaker more often than chance alone would predict (correct orientation: 62.0%; one-tailed t-test for a significant deviation from 50%, $t(35\ d.f.)=7.13$, $p<.001$) (Table 2). The percentage of correct looks was significantly greater than chance for both the intonational phrases condition (correct orientation: 62.1%; $t(35\ d.f.)=6.00$, $p<.001$) and the scrambled words condition (correct orientation: 60.0%; $t(35\ d.f.)=6.46$, $p<.001$). An ANOVA was performed on the percentages of correct looks with the same factors as above. No main effect or interaction was significant.

Analyses of reaction time. The average number of correct orientations was 28.8 for American babies and 28.0 for French babies, $t(34)<1$. For each subject, the average reaction time of correct looks in each of the four conditions (English intonational phrases, English scrambled words, French intonational phrases, and French scrambled words) was calculated. Then an analysis of variance was performed with the factors defined as above.[7]

No main effect was present (all 3 $F(1,34)<2$) and neither were any of the 2-way

TABLE 2

Experiment 2: Percentage of correct looks

Stimuli	*American infants*	*one tail t-test for a significant deviation from 50% (d.f.= 17)*	*French infants*	*one tail t-test for a significant deviation from 50% (d.f.= 17)*
English IP	62.3 %	< .01	65.2 %	< .01
French IP	60.8 %	< .01	65.9 %	< .01
English SW	57.6 %	.01	62.9 %	< .01
French SW	57.4 %	.02	61.5 %	< .01

interaction (all 3 $F(1,34)<1$). However, the triple interaction of Nationality, Language, and Condition was in the predicted direction and approached significance, $F(1,34)=2.95$, $p=.095$. Because we predicted that infants' behavior could be different in the two conditions, the analyses were subsequently restricted to each condition. In the intonational phrase condition, there was a significant Language × Nationality interaction, $F(1,34)=5.67$, $p=.023$, (Figure 2). Posthoc analyses showed that, as in Experiment 1, American infants oriented 410 ms faster to English intonational phrases than to French intonational phrases, $t(17)=2.22$, $p=.040$. In contrast, French infants had a nonsignificant tendency to orient faster to French intonational phrases (96 ms, $t(17)<1$). In the scrambled words condition, the interaction Nationality × Language was not significant, $F(1,34)<1$. American, as well as French infants, showed the same nonsignificant tendency to orient faster to English scrambled words (Figure 2).

DISCUSSION

This experiment confirmed and extended the results of the previous experiment. A Nationality × Language interaction was again observed in the intonational phrase condition. As in Experiment 1, where intonation contours were preserved, infants tended to orient faster toward their native language. This confirms that short utterances with adequate prosody are sufficient to trigger native language recognition in 2-month-olds. However, no such behavior was observed in the scrambled words condition. Although phonological information and word prosodic structure were present in the scrambled words condition, the native utterances lacked global prosodic structure and did not induce reaction time differences.

One issue, of course, is the extent to which there was enough information in the scrambled words utterances to induce a language familiarity effect and how the destruction

[7] Although the American-English and French groups were comparable in gender make up (44.4 % males in the American group vs. 38.9 % in the French group) another ANOVA with sex as an additional between-subject factor was computed as in Experiment 1. There were no significant main effect of sex, nor any interaction between this factor and other factors of the analysis.

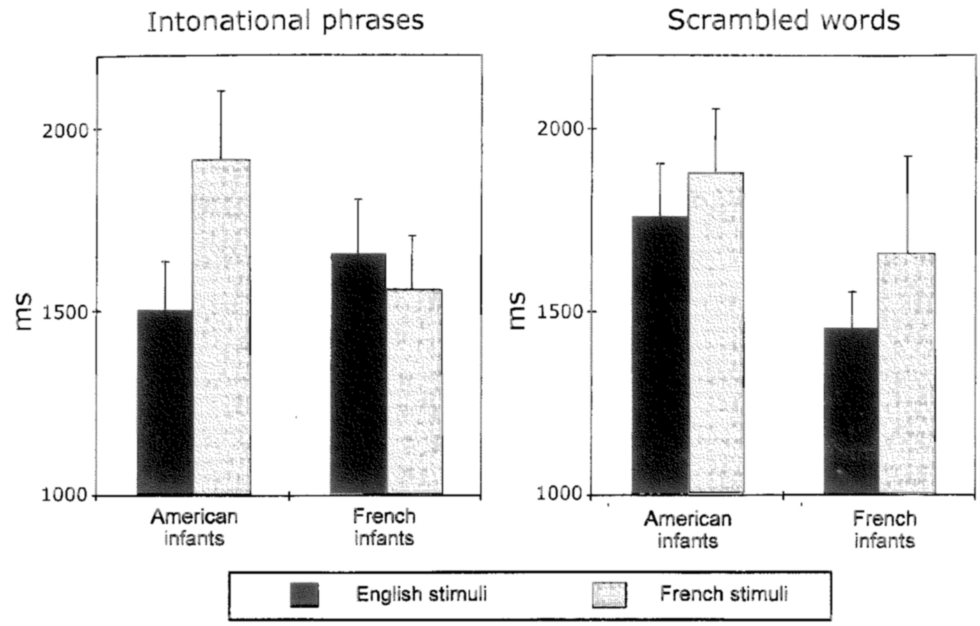

Figure 2

Orientation latency toward intonational phrases and scrambled words in two-month-old French and American infants. Bars represent one standard deviation of the mean.

of the prosodic contour across the utterance could prevent any analysis of smaller units. It has been reported that infants at this age do not yet use phonetic and phonotactic information to distinguish languages. Language-specific responses to phonemes occur only after 4–6 months of age for vowels (Polka & Werker, 1994; Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992) and at the end of the first year for consonants (Werker & Tees, 1984). Six-month-old American infants are not able to discriminate between a list of words in their native language, English, and a list of words in Dutch, apparently because the two languages have a similar prosodic structure. Only by nine months do they appear to use the differences in phonetic composition and phonotactics between the two languages. Furthermore, rhythmic information, present in the scrambled words condition, does not appear to be sufficient to induce language discrimination. Yet, adults perform at a similar level for filtered scrambled words and for filtered intonational phrases, indicating that the scrambled word condition contains enough prosodic information to discriminate the two languages. Van Ooijen, Bertoncini, Sansavini, and Mehler (in press) have shown that neonates do not discriminate between weak-strong bisyllabic words and strong-strong bisyllabic words, suggesting that infants may not initially attend to the word-level prosodic structure. Because the disorganization of the global prosodic pattern in scrambled words could affect the analysis of the smaller units, the present experiment is not sufficient to demonstrate that 2-month-olds, like neonates, are unable to use the words' rhythmic structure. It does suggest, however, that rhythmic properties are not processed independently of the global structure of the utterance and confirms that infants during the first months of life are more likely to attempt a global analysis of continuous speech than a detailed analysis of small units.

GENERAL DISCUSSION

The results of the present experiments contribute to our understanding of language discrimination in three important ways. First, they provide a replication of the findings that 2-month-old infants are able to discriminate between their native language and a foreign language. The replication is crucial because it employs a paradigm different from the sucking paradigms. Second, the experiments demonstrate that language discrimination is a fast process. The mean reaction time to a simple lateralized visual stimulus is around 600 ms at this age (see a summary of published research findings in Canfield et al., 1997, p.20). In Experiment 2, the mean reaction time was 1672 ms, suggesting that infants need little more than one second to recognize their native language. Third, these experiments provide cues about early language representation by indicating the properties of speech to which infants are sensitive. Prosodic information appears to be crucial: Results in Experiment 1 are similar for normal and filtered stimuli, whereas loss of intonational phrasing severely affects infants' behavior in Experiment 2. Furthermore, results of Experiment 2 suggest that 2-month-olds represent prosodic information of intonational phrases and that they can distinguish the prosodic properties of their native language from those of a non-native language. Evidence from other research supports the possibility that young infants are sensitive to information from intonational phrases. Jusczyk (1989) showed that 4½-month-old-infants prefer to listen to utterances in which pauses are inserted at syntactic clauses boundaries than utterances in which pauses are inserted within these clauses. The clauses in Jusczyk's experiment probably correspond to intonational phrases. Thus, these two sets of experiments suggest that young infants listening to continuous speech are able to extract and process prosodic units such as intonational phrases in the speech stream. Further experiments will be necessary to assess whether smaller units, such as phonological phrases, could also support language identification.

An unexpected result, which was found in Experiment 1 and 2, was a bias for infants to orient faster toward English utterances. Such a bias works in combination with the native language effect and contributes to the asymmetry found between the French and the American groups. One possible explanation for this bias is a difference in the experimental material, such as shorter duration of the French stimuli. Note, however, that the difference in duration between the two languages in Experiment 2, while still significant, was minor: around 100 ms. Because we used natural speech from a single speaker, it is possible that in addition to the language effect, peculiarities of this speaker in one of the two languages could have affected the infants' behavior. The stress-timed nature of English or the behavior toward infants in North-American cultures may have induced our speaker to emphasize the child-directed speech properties of speech when speaking English. In further experiments, several different monolingual speakers could be used in each language to discover whether or not the asymmetry encountered in the present experiment is related to speaker idiosyncrasy.

Another possibility is that this bias was related to the languages themselves. Jusczyk et al. (1993) tested American-English and Dutch 9-month-old infants on preference for native and non-native words. Their results were highly similar to the present ones: They reported a significant interaction between infants' nationality and language preference, but also an asymmetry. American infants listened significantly longer to English words, but Dutch infants had only a nonsignificant tendency to prefer words in their native language. One explanation of such asymmetries is that English has a world wide diffusion and can be heard on TV and radio, even in countries where it is not the dominant language. Thus, we can not exclude the possibility that French infants could have had some exposure to English. If in our experiments unusual prosodic structures delay infants' orientation because they are unexpected in the infants' environment, then the behavior differences could be due to French infants being more familiar with English than American infants to French.

A third possibility is that the language structure itself plays a role in the pattern of results. It is possible that the more variable rhythmic pattern of English might attract infants' attention regardless of their native language. Another possible explanation is related to the intonation patterns of the two languages. If an intonation pattern is frequent in French but rare in English, American infants respond more slowly when they hear this unexpected pattern. If, however, the patterns that are frequent in American-English are also quite frequent in French, then French infants would show little reaction to them. To our knowledge, no studies have compared the frequency of the prosodic patterns of intonational phrases in American English and French. These two languages have generally been compared on segmental characteristics, such as phonemes or, at best, on syllabic structures. However, Delattre (1965) has proposed prosodic patterns for sentences in different languages, among them French and English. He notes that continuation and finality are indicated in English by an intonation fall. In French, a continuation is indicated by a rising intonation and a finality by an intonation fall. Whalen, Levitt, and Wang (1991) have studied the multisyllabic productions of English-American and French infants between 7 and 11 months. For American infants, 50% of the productions have a falling intonational pattern and the other half is distributed among four other patterns. For French infants, 33% of the intonation patterns are rising, 33% are falling, and 33% are other patterns. Thus, French babbling has two frequent patterns while English has only one. These authors relate this fact to the frequency of these patterns in the adults' production. These two studies point to the possibility that the distribution of intonation patterns in French and English is asymmetrical. Such an asymmetry might explain the behavioral asymmetry of our subjects. For American infants, the rising patterns of French utterances would have been unexpected because of their low frequency in English; whereas for French infants, neither falling nor rising patterns would have been particularly unexpected because both are frequent in French. This hypothesis is clearly very speculative and deserves further exploration.

CONCLUSION

Short segments of continuous speech (1.2 s on average), are sufficient to induce different behaviors in infants who are exposed to different linguistic environments as long as the global prosodic organization of this segment is coherent. This emphasizes the importance of prosodic structure in young infants' language representations. The present experiments also show that language recognition is fast and illustrate, once more, the striking efficiency of linguistic processes in young infants. Finally, they demonstrate that the eye-orienting method can be used to study linguistic processes in young infants. This new method provides temporal data that reflect the on-line processes involved in continuous speech perception. If, as we suppose, orientation is affected by infants' representation of the stimulus, this method would seem to provide a powerful tool to study the early representations of speech in infants.

Received: February 28, 1997; revised manuscript received: September 25, 1997; accepted: January 15, 1998

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APPENDIX A: Experiment 1: Sentences

One day they set off to see the huge world.
Their mother kissed them on their little cheeks.
She told them to pay attention to the big bad wolf.
The brothers went through the river, which glittered.
The eldest met an old man holding some straw.
May I have some stubble to build a cottage?
The farmer gave him some for eleven coins.
The fat piglet worked hard to finish his hut.
When he had finished he sat down for a while.
Suddenly the horrible beast came along.
The flesh-eating gobbled up his podgy victim.
Then, satisfied, he went on his way to the woods.
The second little pig was walking slowly.
He found a lumberman with a bundle of sticks.
He bought wood to construct a fine little shack.
He painted the door and the windows in purple.
When he had stopped, he felt dirty and tired.
But it's the hairy monster, who arrived then.
He barked to the pig to open the front door.
Then I will destroy your villa with all my breath.
Down came the wooden place in a second time.
The big dog swallowed the fresh and tasty meat.
And he lay down to digest his dinner.
During that time the oldest walked a long way.
He crossed a fellow moving a load of bricks.
May I have some bricks to raise my residence?
The worker sold his bricks to the brave client.
He fixed a big chimney to light a fire.
The country was quiet in the gorgeous sunset.
It was warm and our busy friend was happy.
Then along came the cruel enemy.
My building is like a broad solid castle.
The wolf was very angry and starving.
He came each day and tried to trick the piglet.
The wolf told the sweet pig about a field of turnips.
They are savory, crunchy and delicious.
I will meet you there early in the morning.
But the little one woke up very early.
The voracious robin was still deep asleep.
He was disappointed when he indeed woke up.
Another time he tried another trick.
Once again, our friend got up at sunrise.
He was up in a tree when the hound appeared.
He threw apples at the greedy opponent.
He chased him away then he ran home safely.

Un jour, ils décident de voir le vaste monde.
Leur maman les embrasse sur leurs joues replètes.
Elle leur dit de faire bien attention au loup.
Les trois frères traversent la rivière qui serpente.
Le cadet voit un vieil homme portant de l'herbe.
Donnez-moi de la paille pour faire une maison?
Le fermier lui en donne contre quelque argent.
Le porcelet peine dur pour finir sa hutte.
Lorsqu'il a fini il s'asseoit tout rêveur.
Tout à coup surgit le méchant animal.
Le carnassier engloutit sa victime dodue.
Puis, rassasié, il poursuit sa route vers les bois.
Le second porcelet chemine doucement.
Il trouve un bucheron avec un tas de bois.
Il en achète pour construire une jolie bicoque.
Il peint la porte et les fenêtres en violet.
Quand il termine, il est sale et épuisé.
Mais c'est le monstre poilu qui arrive.
Il crie au cochon d'ouvrir la porte de bois.
Je vais donc dètruire ta villa avec mon souffle.
L'isba cossu s'effondre en un seul instant.
Le grand chien avale la viande fraiche et goûtue.
Et il se couche pour digérer son repas.
Pendant ce temps, l'ainé a marché longtemps.
Il croise un maçon avec un tas de briques.
Donnez-moi des briques pour construire ma demeure?
L'ouvrier vend ses briques au brave client.
Il crée une cheminée pour faire un beau feu.
La campagne est calme dans le soleil couchant.
Il fait chaud et notre jeune ami est heureux.
Bientôt arrive le féroce ennemi.
Ma maison est comme un imposant chateau.
Le loup est très en colère et affamé.
Il vient chaque jour et tente de prendre le goret.
Le loup parle au cochon d'un champ de navets.
Ils sont savoreux, croquants et délicieux.
Je te verrai là au lever du soleil.
Mais le marcassin se lève de très bonne heure.
Le bandit affamé est toujours au lit.
Il est très déçu quand il se réveille enfin.
Une autre fois il tente une autre ruse.
De nouveau, notre ami est debout dès l'aube.
Il est en haut de l'arbre quand l'affreux arrive.
Il lance des pommes à son vorace adversaire.
Il le chasse au loin, puis il court sain et sauf.

The circus settled in the nearest village.	Le cirque s'installe dans le village le plus proche.
The young little pig would like to have great fun.	Le jeune cochonnet aimerait s'amuser.
He left for the beautiful fair at sunlight.	Il part à la fête foraine à l'aurore.
But the nasty hoped to catch him over there.	Mais, le vilain espère l'attraper là-bas.
Our fat buddy noticed the gangster.	Notre gros copain aperçoit le bandit.
Quickly he hid in a big barrel which rolled.	Très vite il saute dans un grand tonneau qui roule.
And the barrel nearly knocked the scroundel over!	Et le tonneau rate de justesse le gredin.
He opened the door and gave the key a turn.	Il ouvre la porte et ferme à triple tour.
The wolf was furious and cried out with anger.	Le loup est furieux et rugit avec colère.
But the little pig was quite safe in his house.	Mais le porcelet est à l'abri chez lui.
I am coming to get you, nasty little piglet.	Je viens t'attraper, vilain petit cochon.
I will come down your solid chimney to eat you.	Je vais descendre par la cheminée te manger.
But the malicious animal had made a big fire.	Mais le malicieux animal a fait un feu.
He had put a huge pot of water to boil.	Il a mis un grand pot d'eau chaude à bouillir.
but he fell into the pot of boiling water.	mais il tombe dans le chaudron plein d'eau bouillante.
And that was the end of the cruel beast.	Et c'en est fini du sale animal.
He never saw a big bad wolf in the wood.	Il n'a plus vu de méchant loup dans les bois.
He got married and had a lot of children.	Il s'est marié et a eu beaucoup d'enfants.
He often told the sad story of the wolf.	Il conte souvent la triste histoire du grand loup.

APPENDIX B: Experiment 2: Intonational phrases

to see the huge world.	de voir le vaste monde.
Their mother kissed them	Leur maman les embrasse
The eldest met an old man	Le cadet voit un vieil homme
holding some straw.	portant de l'herbe.
May I have some stubble	Donnez-moi de la paille
The farmer gave him some	Le fermier lui en donne
The fat piglet worked hard	Le porcelet peine dur
to finish his hut.	pour finir sa hutte.
When he had finished	Lorsqu'il a fini
he sat down for a while.	il s'asseoit tout rêveur.
little pig let me in	petit cochon ouvre-moi
cried the little pig.	hurle le petit cochon.
And the wolf said	Le loup répond
will blow your house down	ta chaumière tombera
he went on his way	il poursuit sa route
He found a lumberman	Il trouve un bucheron
He painted the door	Il peint la porte
When he had stopped	Quand il termine
he felt dirty and tired.	il est sale et épuisé.
But it's the hairy monster	Mais c'est le monstre poilu
He barked to the pig	Il crie au cochon
to open the front door.	d'ouvrir la porte de bois.

I will destroy your villa
Down came the wooden place
And he lay down
to digest his dinner.
the oldest walked a long way.
He crossed a fellow
the little one woke up
May I have some bricks
to raise my residence
The worker sold his bricks
to light a fire.
The country was quiet.
our busy friend was happy.
I won't let you in!
answered our splendid friend.
He tried and tried
he could destroy nothing.
The wolf was very angry
tried to trick the piglet.
The wolf told the sweet pig
They are savory,
I will meet you there
He took some turnips
he sprinted quickly back
He was disappointed
when he indeed woke up.
he tried an other trick.
He was up in a tree
when the hound appeared.
He threw apples
He chased him away,
he ran home safely.
The circus settled
to catch him over there.
he hid in a big barrel
He opened the door
and gave the key a turn.
The wolf was furious
cried out with anger.
I'm coming to get you
He got married
and had a lot of children.

Je vais donc détruire ta villa
L'isba cossu s'effondre
Et il se couche
pour digérer son repas.
l'ainé a marché longtemps.
Il croise un maçon
le marcassin se lève
Donnez-moi des briques
pour construire ma demeure?
L'ouvrier vend ses briques
pour faire un beau feu.
La campagne est calme
notre jeune ami est heureux.
tu n'entreras pas!
répond le fier sanglier.
Il se déchaîne
il ne peut rien détruire.
Le loup est très en colère
tente de prendre le goret.
Le loup parle au cochon
Ils sont savoreux,
Je te verrai là
Il cueille quelques navets
est de retour très vite
Il est très déçu
quand il se réveille enfin.
il tente une autre ruse.
Il est en haut de l'arbre
quand l'affreux arrive.
Il lance des pommes
Il le chasse au loin,
il court sain et sauf.
Un cirque s'installe
l'attraper là-bas.
il saute dans un grand tonneau
Il ouvre la porte
et ferme à triple tour.
Le loup est furieux
rugit avec colère.
Je viens t'attraper
Il s'est marié
et a eu beaucoup d'enfants.

APPENDIX C: Experiment 2: Scrambled words

little, set off, mother	petits, décident, maman
huge world, attention	vaste monde, attention
holding, old man, eldest	portant, vieil homme, cadet
finish, brothers, painted	finir, trois frères, donnez
glittered, river, cottage?	serpente, rivière, maison?
chinny, fat piglet	porcelet, menton
sat down, second	s'asseoit, second
was walking, horrible beast	animal, méchant, chemine
little shack, slowly	doucement, bicoque
fell down, cabin, flesh-eating	s'écroule, cabane, carnassier
victim, podgy, gobbled up	dodue, victime, engloutit
went on, satisfied	poursuit, rassasié
little pig, construct	porcelet, construire
curly, had stopped, monster	ami, termine, monstre
residence, tired	épuisé, demeure
little tail, open	tire bouchon, d'ouvrir
young wild boar, courageous	marcassin, courageux
dirty, villa	rêveur, villa
second, wooden, down came	instant, s'effondre, cossu
tasting, swallowed, big dog	goûtue, avale, grand chien
dinner, digest, laid down	repas, digérer, se couche
oldest, during	pendant, ainé
cold morning, performed, latter	matin froid, travaille, dernier
fire, chimney, along	beau feu, cheminée, arrive
sunset, gorgeous, country	couchant, soleil, campagne
happy, busy friend	heureux, jeune ami
enemy, cruel, enter	animal, féroce, entrer
turnips, answered	navets, repond
trumpet, castle, building	trompette, chateau, maison
piglet, destroy, pretty	goret, détruire, jolie
savory, sweet pig	savoureux, cochon
delicious, crunchy	délicieux, croquants
robin, voracious	affamé, bandit
woke up, huge hound	molosse, réveille
apple trees, spendid friend	pommiers, fier sanglier
appeared, worker	arrive, l'ouvrier
opponent, greedy	adversaire, vorace
little pig, brave client	cochonnet, brave client
solid, beautiful fair	imposant, fête foraine
criminal, nasty	criminel, vilain
scroundel, big barrel, quickly	gredin, grand tonneau, très vite

nearly, barrel	justesse, tonneau
starving, angry, opened	affamé, colère, tempête
anger, cried out, furious	colère, rugit, furieux
angry, disappointed	faché, désappointé
chimney, solid, noticed	méchant, aperçoit, chaudron
huge pot, come down	grand pot, descendre
water, malicious, foolish	eau chaude, malicieux, idiot
huge chimney, animal	cheminée, animal
happily, married	heureux, marié
children, story, suddenly	enfants, histoire, tout à coup
disappointed, bundle	argent, deçu, embrassent
little cheeks, destroy	joues replètes, détruire
solid, went through, stubble	cochon, traversent, l'isba
asleep, moving, sunrise	repond, déchaine, l'affreux
shouted, castle	construire, chateau
long way, eleven	longtemps, tempêter
sunlight, boiling, ever	aurore, bouillante, depuis
often, big bad wolf, woke up	méchant loup, souvent, se lève
early, nothing, fellow	bonne heure, verrai, maçon
coming, again, would like	l'attraper, aimerait, nouveau
hairy, indeed, nasty	poilu, cochon, vilain
again, safely, sprinted	soufflerai, encore, marché
nearest, never, turnips	navets, chaumière, bientôt