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Brief article

The development of perceptual grouping biases in infancy: A Japanese-English cross-linguistic study

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ABSTRACT

Perceptual grouping has traditionally been thought to be governed by innate, universal principles. However, recent work has found differences in Japanese and English speakers' non-linguistic perceptual grouping, implicating language in non-linguistic perceptual processes (Iversen, Patel, & Ohgushi, 2008). Two experiments test Japanese- and English-learning infants of 5–6 and 7–8 months of age to explore the development of grouping preferences. At 5–6 months, neither the Japanese nor the English infants revealed any systematic perceptual biases. However, by 7–8 months, the same age as when linguistic phrasal grouping develops, infants developed non-linguistic grouping preferences consistent with their language's structure (and the grouping biases found in adulthood). These results reveal an early difference in non-linguistic perception between infants growing up in different language environments. The possibility that infants' linguistic phrasal grouping is bootstrapped by abstract perceptual principles is discussed.

1. Introduction

Perceptual grouping is the psychological segmentation of sequences into chunks. Segmentation is typically based on the physical properties of items in the sequence, but can even be observed in sequences of physically identical sounds, as when identical metronome ticks are heard as pairs of tones, sounding like *tick–tock* (Bolton, 1984). The principles governing abstract perceptual grouping have long been considered automatic and not culturally dependent. For example, the following two principles have been proposed as universal: (1) louder sounds mark group beginnings, and (2) longer sounds mark group endings (Woodrow, 1909). These principles are also known as the Iambic/Trochaic Law (Hayes, 1995) (see Fig. 1).

The current focus is on the duration principle, stipulating that varying the duration of elements in a sequence results in perception of iambs (weak–strong, i.e., short–long). This principle has generally been experimentally upheld. In one study, English-speaking adults were exposed to a sequence of complex tones with every third tone lengthened (. . .short–short–long–short–short–long. . .) (Trainor & Adams, 2000). A longer silence was then inserted between some tones, with the assumption that an increased gap would be more difficult to detect if it coincided with a group boundary (Thorpe & Trehub, 1992). Participants experienced more difficulty detecting gaps after long tones than

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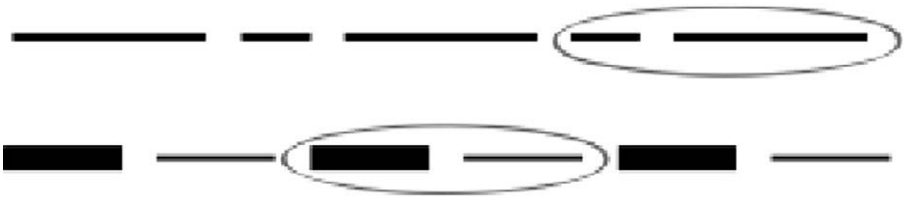

Fig. 1. Schematic of universal perceptual principles (Iambic/Trochaic Law). Top: iambic duration principle. Bottom: trochaic intensity principle.

after short tones, suggesting the presence of an implicit segmentation point after long tones (i.e., [short–short–long]–[short–short–long]...), consistent with the duration principle. A group of 8-month-old English-learning infants were tested in a similar paradigm, and were also significantly less likely to notice gap increases after long tones than after short tones (Trainor & Adams, 2000). These results suggest that perceptual grouping in English language environments conforms to the iambic duration principle by 8 months of age.

It has been hypothesized that the language environment might impact individuals' perceptual grouping (Jakobson, Fant, & Halle, 1952). For example, stress patterns differ in English and French speech. Although the predominant stress pattern for English words is trochaic (strong–weak; *ENGlish*), French has no formal word stress/accent (at the lexical level). Rather, stress emerges over groups of words/phrases (weak–strong; *le CHAT*), resulting in French words being most commonly uttered in an iambic pattern (*Fran-ÇAIS*). By 9 months of age, English infants are sensitive to their native pattern, preferring words that carry the predominant trochaic stress (Jusczyk, Cutler, & Redanz, 1993). To explore this linguistic impact on perceptual grouping, Hay and Diehl (2007) asked English and French adults whether they perceived iambs or trochees in an alternating duration tone sequence (short–long–short–long). Regardless of native language, participants perceived iambs; native language did not affect grouping. Notably, this was the case whether the sound stimuli were tones or language syllables, suggesting that linguistic grouping might be governed by more abstract, universal principles.

An alternative perspective on these results draws on the fact that although the lexical patterns in English and French input may differ, the languages have similar phrasal structures. At the phrasal level, English, like French, is predominantly iambic (e.g., *the CAT*) (Nespor & Vogel, 1986; Nespor et al., 2008). On this view, the similarity in French and English individuals' grouping behaviour could still be consistent with an influence of language, at the phrasal rather than the lexical level (Iversen et al., 2008; Werker & Gervain, in press). To study the phrasal influence of language previous research has compared adult participants from English and Japanese language environments (Iversen et al., 2008; see also Kusumoto & Moreton, 1997). English and Japanese use opposite word orders (i.e., verb–object (VO) versus object–verb (OV)), and word order is correlated with phase level prosody. Moreover, among languages that differ in their word orders, English and Japanese are predicted to be among the most distinct in phrasal level prosody (Nespor et al., 2008). Iversen and colleagues (2008) presented Japanese and English listeners with non-speech tones alternating in duration. As expected, the English listeners grouped iambically, but the Japanese group was heterogeneous, with slightly more participants grouping the opposite way, into trochees. These results run counter to the duration principle, challenging its universality. However, these cultural–linguistic differences could be reconciled with a universal, innate bias if perception is similar early in life, before culturally-induced grouping patterns develop.

As noted, 8-month-old English-learning infants' perception already appears to conform to the iambic duration principle (Trainor & Adams, 2000), and 7-month-old bilingual infants (learning English and another language with opposite word order such as Japanese, Hindi, or Punjabi) are able to use duration cues to set word order in an artificial language (Gervain & Werker, 2008). However, in another study, 6.5-month-old English-learning infants were not able to group consistently when statistical and duration cues pointed to the same boundary (Hay & Saffran, in preparation), suggesting that sensitivity to durational grouping cues might be less developed around 6 months of age (although interference from the statistical cues could also be responsible for the lack of grouping preferences).

The present goal was to observe cross-linguistic grouping preferences of non-linguistic durational contrasts in infancy. Experiment 1 tested English-learning infants to replicate the iambic duration pattern found by 8 months (Trainor & Adams, 2000), and to probe younger infants for evidence of a developmental trajectory. A second experiment tested Japanese-learning infants to compare perceptual development across language environments. It was hypothesized that the older infants would be distinguished by the same cultural/linguistic pattern as adults. Infants were familiarized to tones alternating in duration (...short–long–short–long...) and grouping was assessed by examining infants' subsequent relative preference for iambic and trochaic test trials. If no grouping strategy were present there should be equal preference for each test trial type. However if infants segmented the familiarization sequence into iambs there should be a novelty preference for the opposite trochaic test trials, and segmentation into trochees should lead to a novelty preference for the iambic test trials.

2. Experiment 1. A developmental pattern: English-learning infants

2.1. Method

2.1.1. Participants

Participants were 20 5–6-month-old (M = 196 days, range = 173–209) and 20 7–8-month-old (M = 241 days,

range = 215–261) healthy, English-learning infants in Vancouver, Canada.

2.1.2. Stimuli

The tone stimuli characteristics were modeled on those of Trainor and Adams (2000). Two complex tones were created, a shorter one 200 ms in duration and a longer one of 600 ms. They had a fundamental frequency of 256 Hz, and were composed of the first 10 harmonics with an intensity rolloff of 6 dB/octave. A 2 min familiarization alternated the two tones, with all inter-stimulus intervals (ISIs) 200 ms long, yielding stimulus onset asynchronies (SOAs) of 800 ms before the shorter tones and 400 ms before the longer tones. Test trials were 15 s and increased the ISI by 100–300 ms after the long tone in the iambic test trials and after the short tone in the trochaic test trials (SOA increased by 100 ms after group-final tone) (Trainor & Adams, 2000). The familiarization onset and offset were ramped, and counterbalanced for first and last tone between infants to counter any grouping bias based on the initial (or final) tone. The test trials were not ramped or counterbalanced (i.e., iambic trials always began with a short tone). The stimuli were measured to fall between 67 and 70 dB SPL, a comfortable sound level for infants.

2.1.3. Procedure

Infants were tested individually on their parents' laps in a head-turn preference paradigm (on which infants as young as 4.5 months reveal preferences; Kemler Nelson et al., 1995). A green light was mounted to the front of the infant and a red light was mounted to each side. During the familiarization phase, the lights blinked contingently on infants' looking, but were unrelated to the (constant) sound presentation. Twelve test trials were presented in a pseudo-random order, counterbalanced for first trial and side of presentation. Infants' attention was first drawn to the centre light, which was then extinguished and either the right or the left green light began blinking. When infants looked to that light, the test trial sequence would begin playing from behind the light, until they looked away for more than 2 s, or the 15 s trial was complete. The experiment was run using E-Prime and controlled by an experimenter in an adjoining room who was watching the infant through a closed-circuit monitor, unable to hear the stimuli being played.

2.2. Results

The online looking times were averaged and submitted to a 2 (age) × 2 (test trial type: iambic or trochaic) ANOVA.

The interaction was significant [$F(1, 38)=4.16$, $p = 0.048$]. Simple main effects confirm the 5–6 month-olds had no preference [$F(1, 38)=0.232$, $p = 0.63$], whereas the 7–8 month-olds favoured trochaic trials [$F(1, 38)= 5.78$, $p = 0.021$] (Fig. 2).

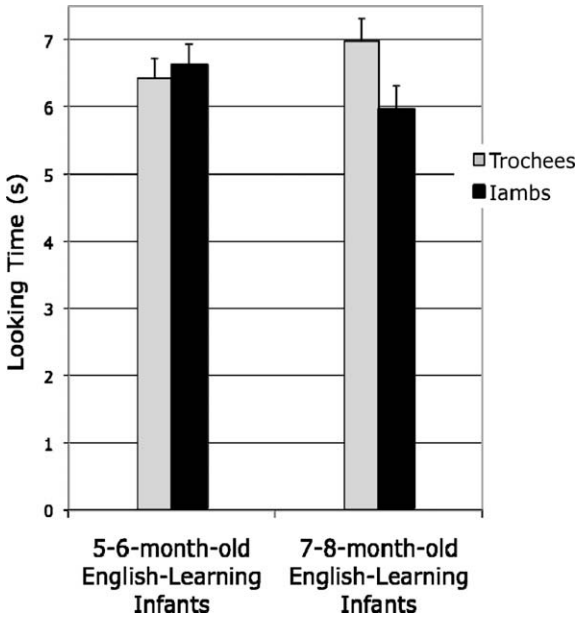

Fig. 2. Experiment 1: average looking times (s) of English infants to the iambic and trochaic test trials. Error bars denote standard error.

2.3. Discussion

When exposed to a durational tone sequence, the 5–6-month-old infants did not reveal any grouping bias. These results were found despite already developed sensitivity to auditory phrasal and rhythmic information (Christophe, Nespor, Dupoux, Guasti, & van Ooyen, 2003; Krumhansl & Jusczyk, 1990; Mandel, Jusczyk, & Kemler Nelson, 1994; Nazzi, Bertoncini, & Mehler, 1998) and ability to show preferences in HPP (e.g., Johnson & Tyler, in press; Mandel, Jusczyk, & Pisoni, 2006; Nazzi, Jusczyk, & Johnson, 2000). In contrast, the 7–8-month-olds segmented the into iambs. This conclusion was reached in accordance with the a priori prediction of a novelty preference. The simple, repetitive stimuli (two alternating tones) were presented for a full 2 min, making a novelty preference more likely (Hunter & Ames, 1988). Further, the stimuli parameters were identical to those in a previous study that used a conditioned head-turn (CHT) paradigm (which does not rely on any novelty/familiarity interpretation), and those results yielded evidence of 8-month-olds' grouping after the long tone (Trainor & Adams, 2000). Given that the present work includes similarly aged infants raised in a similar language environment, the expectation of convergence supports a novelty preference. Thus the present results reveal a developing tendency to group duration sequences into iambs, the same as English-speaking adults (Iversen et al., 2008).

Previous work has shown that English-learning infants develop a preference for disyllabic words with trochaic stress by 9 months of age (Jusczyk et al., 1993; Turk, Jusczyk, & Gerken, 1995). The present study reveals that the cultural pattern of non-linguistic grouping develops during a similar period, from 5–6 to 7–8 months. The current preference is consistent with the predominantly iambic phrasal pattern of English (Iversen et al., 2008), suggesting that infants interpreted the sound stream as phrasal units rather than (trochaic) disyllabic words. The level of segmentation applied in any given situation likely depends primarily on the precise properties of the stimuli (Werker

& Curtin, 2005). Words in lexical stress studies tend to be clearly segmented, allowing for the emergence of lexical preferences (Jusczyk et al., 1993; Turk et al., 1995); however, in the present study, the constant stream of sound makes a phrasal analysis more likely, as phrases must be defined before words.

The perception of iambs is consistent with the phrasal structure of language but also with the iambic duration principle, meaning that grouping could have been driven either by language structure or a language-invariant principle. To tease these factors apart, infants being raised with a language with a different phrasal structure and prosody needed to be studied.

3. Experiment 2. A cultural developmental pattern: Japanese-learning infants

This experiment was designed to investigate the perceptual development of infants being raised in a Japanese language environment. Recall that the Japanese-speaking adults displayed a heterogeneous pattern of grouping, with many of the participants grouping like the English adults into iambs, but more participants grouping oppositely into trochees (Iversen et al., 2008).

It was expected that the younger, 5–6-month-old Japanese infants, like their English-learning counterparts, would not reveal any grouping biases. However, the prediction for the 7–8-month-old Japanese infants was less clear. One possibility was that the infants might behave similarly to the English-learning infants, consistent with an initial universal bias. Another possibility is that by 7–8 months the Japanese infants might have acquired a cultural pattern of perception more characteristic of Japanese adults (no grouping consensus).

3.1. Method

3.1.1. Participants

Participants were 20 5–6-month-old (M = 184 days, range = 160–198), and 20 7–8-month-old (M = 235 days, range = 214–266) healthy, Japanese-learning infants from the Saitama prefecture of Japan.

3.1.2. Procedure and stimuli

The testing room and procedure were the same as those of Experiment 1, except that the sounds were played at 63–66 dB SPL, which was found to be a comfortable sound level for the infants.

3.2. Results

As in Experiment 1, the data were averaged over all 12 test trials, and submitted to a 2 (age) × 2 (test trial type: iambic or trochaic) ANOVA. The interaction was not significant [$F(1, 38)$=0.88, p = 0.35]. Simple main effects revealed that neither the 5–6 month-olds [$F(1, 38)$<0.001, p = 0.97], nor the 7–8 month-olds [$F(1, 38) = -1.81$, p = 0.19] revealed any grouping preference (Fig. 3).

To compare the results across cultures, the data from Experiments 1 and 2 were submitted to a 2 (test trial type) × 2 (age group) × 2 (culture) ANOVA. The 3-way interaction was significant [$F(1, 76)$=4.62, p = 0.035], carried by the significant preference of the English 7–8 month-old infants for trochees. None of the 2-way interactions approached significance.

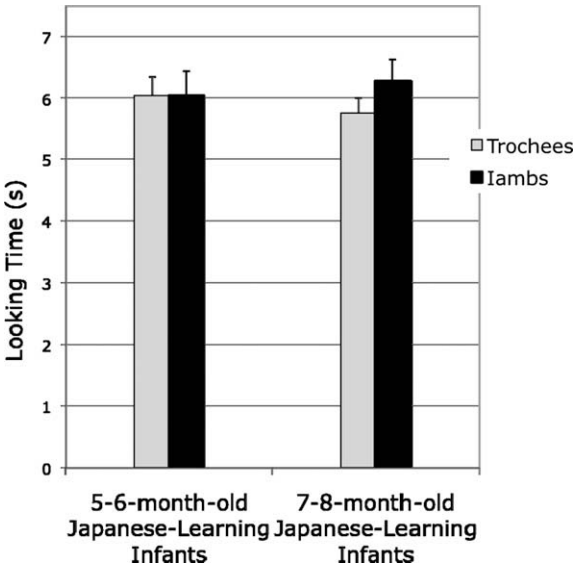

Fig. 3. Experiment 2: average looking times of the Japanese infants to the iambic and trochaic test trials. Error bars denote standard error.

3.3. Discussion

These results confirm that across two structurally different language environments, infants of 5–6 months of age do not reveal any grouping biases for the durational tone stimuli. However, by 7–8 months of age, unlike the English-learning infants, the Japanese infants did not develop any grouping preference. A perceptual pattern significantly different than that of the English infants is revealed, demonstrating a clear divergence across development between Japanese and English infants' perceptual groupings.

The present results mirror the cultural differences found in adulthood where the Japanese adults also did not reveal any overall grouping consensus (Iversen et al., 2008). This pattern of non-linguistic auditory perception is consistent with the cross-linguistic differences in word order, and the timing of the non-linguistic development coincides with the emergence of language-specific word order at 8 months of age (Gervain, Nespor, Mazuka, Horie, & Mehler, 2008), further tying the linguistic and non-linguistic grouping processes.

4. General discussion

The possibility of an universal bias in non-linguistic grouping perception was probed by testing infants from Japanese and English language environments. At 5–6 months, neither the Japanese nor the English infants revealed any systematic grouping strategy, arguing against an innate bias. However, the 7–8-month-olds diverged in

a pattern strikingly similar to that observed in adulthood: the English infants perceived iambs, and the Japanese infants did not develop any overall grouping strategy. There may be a similar cultural pattern in 18-month-old infants' babbling (Hallé, de Boysson-Bardies, & Vihman, 1991).

One interpretation of these findings is that non-linguistic duration-based grouping is not governed by universal, inborn principles, but emerges entirely from bottom-up statistical learning of duration patterns at phrase boundaries in the auditory environment (dominated by speech for humans). That the cultural pattern is observed in 7–8-month-olds, but not 5–6-month-olds, is consistent with an accumulative/statistical learning hypothesis. English word order leads to many short–long phrases (e.g., *at HOME*), while Japanese has the opposite pattern (*UCHI ni*). Both languages, however, have intonational phrases marked by final lengthening. Thus English (but not Japanese) provides consistent cues to duration at phrase boundaries, potentially explaining the consistency among English listeners in their duration-based grouping preferences, versus the heterogeneity of Japanese listeners.

Another intriguing way of explaining the linkage between linguistic and non-linguistic grouping perception is that infants' linguistic phrasal grouping could be bootstrapped by abstract, universal principles. Universal principles, at first glance, run counter to the current finding of early cross-cultural differences in the development of grouping perception, but could interact with the language environment to result in different perceptual patterns. According to the Iambic/Trochaic Law, group beginnings are suggested by louder sounds, and group endings are suggested by longer sounds (Allen, Hawkins, & Morris, 1979; Hayes, 1995). Complements (*home*), at least open-class ones, typically carry more perceptual prominence than heads (*at*) (Nespor & Vogel, 1986), thus, proper groups could be telegraphed using complement stress: head-complement (HC) groups could be conveyed using lengthened duration (*at HOME*), and complement-head (CH) groups could be conveyed using increased intensity (*UCHI ni*) (Nespor, Guasti, & Christophe, 1996; Nespor et al., 2008).

For this bootstrapping hypothesis to be viable, it would require that: (1) language structure take advantage of these perceptual principles, and (2) infants be sensitive to the implications. To the first point, measurements show that the manner of complement prominence changes systematically depending on a language's word order. An HC language (French) was found to mark complements with duration, a CH language (Turkish) was found to mark complements with amplitude and pitch and most tellingly, a language that uses both word orders (German) marked complements with the expression of prominence that corresponded to head direction (Nespor et al., 2008).

To the second point, the present findings are consistent with an emergence of principled perception by 7–8 months of age, when infants process durational cues with differential sensitivity as predicted by relevance in their language. According to the Iambic/Trochaic Law, duration is the relevant grouping cue for individuals immersed in an iambic/HC language. The English-learning infants in Experiment 1 are learning an iambic/HC language, and indeed, their behaviour revealed sensitivity to duration, with a clear consensus to place longer elements group-final, as in language. Grouping is more difficult to predict in infants being raised in language environments where the perceptual cue is irrelevant/inconsistent (i.e., in trochaic/CH language environments, intensity and pitch are more important or consistent (Nespor et al., 2008)). Some possible interpretations of an irrelevant/inconsistent duration cue are: no overall grouping strategy (insensitivity to the non-predictive cue), perception of iambs (iambic duration principle), and perception of trochees (duration perceptually "co-opted" to be consistent with native prominence placement; i.e., perceiving stress generally rather than intensity or duration specifically). The Japanese infants in Experiment 2 did not reveal any overall grouping tendency, suggesting that they found duration cue irrelevant. Similarly, the Japanese adults were split overall, although each individual was steadfast in her individual judgment (Iversen et al., 2008); it is possible that multiple perceptual patterns might be available in infancy, with one eventually coming to dominate.

In sum, these studies provide evidence that non-linguistic grouping perception develops by 7–8 months of age in tandem with native linguistic structure. The cross-linguistic pattern may result from universal perceptual principles that, rather than straightforwardly directing perception, are interpreted according to the language environment. Such a process might bootstrap phrasal grouping, an essential part of language acquisition.

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References

Allen, G., Hawkins, S., & Morris, M. (1979). Development of 'nuclear accent' marking in children's phrases. In H. Hollien & P. Hollien (Eds.), *Current Issues in the Phonetic Sciences* (pp. 919–926). Amsterdam: John Benjamins.

Bolton, T. (1984). Rhythm. *The American Journal of Psychology, 6*, 145–238.

Christophe, A., Nespor, M., Dupoux, E., Guasti, M.-T., & van Ooyen, B. (2003). Reflections on prosodic bootstrapping: Its role for lexical and syntactic acquisition. *Developmental Science, 6*, 213–222.

Gervain, J., Nespor, M., Mazuka, R., Horie, R., & Mehler, J. (2008). Bootstrapping word order in prelexical infants: A Japanese–Italian cross-linguistic study. *Cognitive Psychology, 57*, 56–74.

Gervain, J., & Werker, J.F. (2008). Frequency and prosody boostrap word order: A cross-linguistic study with 7-month-old infants. In: Paper presented at the *33rd Boston University conference on language development*, Boston, MA.

Hallé, P. A., de Boysson-Bardies, B., & Vihman, M. (1991). Beginnings of prosodic organization: intonation and duration patterns of disyllables produced by Japanese and French infants. *Language and Speech, 34*, 299–318.

Hay, J. S. F., & Diehl, R. L. (2007). Perception of rhythmic grouping: Testing the Iambic/Trochaic law. *Perception & Psychophysics, 69*, 113–122.

Hay, J. S. F., & Saffran, J. R. (in preparation). The development of rhythmic grouping biases in infancy.

Hayes, B. (1995). *Metrical stress theory: Principles and case studies*. Chicago: Univ. of Chicago Press.

Hunter, M. A., & Ames, E. W. (1988). A multifactor model of infant preferences for novel and familiar stimuli. *Advances in Infancy Research, 5*, 69–95.

Iversen, J. R., Patel, A. D., & Ohgushi, K. (2008). Perception of rhythmic grouping depends on auditory experience. *Journal of the Acoustical Society of America, 124*, 2263–2271.

Jakobson, R., Fant, G., & Halle, M. (1952). Preliminaries to speech analysis: The distinctive features and their correlates. Acoustics Laboratory, MIT, Technical Report No. 13. (Republished by MIT Press, Cambridge, MA, 7th ed., 1967).

Johnson, E.K., & Tyler, M. (in press). Testing the limits of statistical learning for word segmentation. *Developmental Science*. doi:10.1111/j.1467-7687.2009.00886.x.

Jusczyk, P. W., Cutler, A., & Redanz, N. J. (1993). Infants' preference for the predominant stress patterns of English words. *Child Development, 64*, 675–687.

Kemler Nelson, D. G., Jusczyk, P. W., Mandel, D. R., Myers, J., Turk, A., & Gerken, L. (1995). The headturn preference procedure for testing auditory perception. *Infant Behavior and Development, 18*, 111–116.

Krumhansl, C., & Jusczyk, P. (1990). Infants' perception of phrase structure in music. *Psychological Science, 1*, 70–73.

Kusumoto, K., & Moreton, E. (1997). Native language determines parsing of non-linguistic rhythmic stimuli. *Journal of the Acoustical Society of America, 105*, 3204.

Mandel, D. R., Jusczyk, P. W., & Kemler Nelson, D. G. (1994). Does sentential prosody help infants to organize and remember speech information? *Cognition, 53*, 155–180.

Mandel, D. R., Jusczyk, P. W., & Pisoni, D. (2006). Infants' recognition of the sound patterns of their own names. *Psychological Science, 6*, 314–317.

Nazzi, T., Bertoncini, J., & Mehler, J. (1998). Language discrimination by newborns: Towards an understanding of the role of rhythm. *Journal of Experimental Psychology: Human Perception & Performance, 24*, 756–766.

Nazzi, T., Jusczyk, P. W., & Johnson, E. K. (2000). Language discrimination by English-learning 5-month-olds: Effects of rhythm and familiarity. *Journal of Memory and Language, 43*, 1–19.

Nespor, M., Guasti, M. T., & Christophe, A. (1996). Selecting word order: The rhythmic activation principle. In U. Kleinhenz (Ed.), *Interfaces in Phonology* (pp. 1–26). Berlin: Akademie Verlag.

Nespor, M., Shukla, M., Avesani, C., van de Vijver, R., Schraudolf, H., & Donati, C. (2008). Different phrasal prominence realizations in VO and OV languages. *Lingue e Linguaggio, VII*(2), 1–28.

Nespor, M., & Vogel, I. (1986). *Prosodic phonology*. Dordrecht: Foris.

Thorpe, L. A., & Trehub, S. E. (1992). Duration illusion and auditory grouping in infancy. *Developmental Psychology, 25*, 112–127.

Trainor, L. J., & Adams, B. (2000). Infants' and adults' use of duration and intensity cues in the segmentation of tone patterns. *Perception & Psychophysics, 62*, 333–340.

Turk, A. E., Jusczyk, P. W., & Gerken, L. A. (1995). Do English-learning infants use syllable weight to determine stress? *Language and Speech, 38*, 143–158.

Werker, J. F., & Curtin, S. (2005). PRIMIR: A developmental framework of infant speech processing. *Language Learning and Development, 1*(2), 197–234.

Werker, J. F., & Gervain, J. (in press). Speech perception and phonological development. In: P. D. Zelazo (Ed.), *The Oxford handbook of developmental psychology*.

Woodrow, H. (1909). A quantitative study of rhythm: The effect of variations in intensity, rate and duration. *Archives of Psychology, 14*, 1–66.