Brian Highfill
ISE 575
1/26/10

Perception of Rhythmic Grouping Depends on Auditory Experience

By John R. Iversen, Aniruddh D. Patel, Kengo Ohgushi

This work investigates the relationship between the perception of groupings of both linguistic and nonlinguistic rhythm (for example music). The perception of rhythmic grouping in humans is an automatic cognitive phenomenon whereby the listener perceives groups of rhythm that belong together. The patterns abstract hierarchies of structure which may help the listener parse and segment the sounds into meaningful units.

It has long been held that the grouping mechanism of the human brain is innate and that the principles by which groupings are formed is universal across all people. The research presented by this paper challenges this idea. The paper can be broken into roughly two parts: an experiment that was performed to show perception of rhythmic grouping is biased by culture, and the proposal of a hypothesis which may account for such a bias based on the primary language of an individual.

For nearly one hundred years, there were two principles thought to govern rhythmic grouping in auditory perception: “louder sounds tends to mark the beginning of a [rhythmic] group and a lengthened sound (or interval between sounds) tends to mark the end of a group.” The problem, as the authors see it, was that the research done to produce these principles was based on experiments with only westerners (English and French). This experiment focuses on a group of English speakers and Japanese speakers (non-westerners). In order to measure grouping perception of the participants, each was made to listen to an artificial auditory clip using “simple tone sequences in which sound alternate in a single parameter (amplitude or duration).” Individuals were then asked to report whether they heard a long-short or short-long sequence and in another test whether they heard soft-loud or loud-soft sequences. As an important design of the experiment, intended to eliminate bias caused by the tone heard first in the sequence, the amplitude of each sequence was faded in and out slowly making it unclear which part of the sequence is heard first.

The results showed that while both groups of participants generally perceived the loud-soft grouping as opposed to soft-loud, the English group was biased in perceiving the short-long sequence (the Japanese speakers had uneven preferences for both short-long and long-short sequences). These support the first long-held belief that louder sounds are heard first universally, but it tends to refute the second. In particular, there appears to be cultural bias on the perceptual grouping of long and short tones of equal amplitude.

The authors proposed a hypothesis which may explain the data from the experiment: the bias seen between cultures is due to the individual primary auditory experience in humans (language), and that the “head direction” of various languages is to blame. Specifically, the order of linguistic function words (functors) and content words is opposite in English and Japanese. In English, functors (i.e. “the”, “to”, etc.) come before the content word (“dog”, “eat”, etc.). Additionally, functors tend to be monosyllabic (short sounding), but content words may be multisyllabic. In Japanese, the functor/content-word order is reversed but the same relationship among the respective sound durations of functors and content words hold.

This may explain why the short-long sequence is perceived with English speakers and the opposite is perceived by Japanese speakers. Specifically, the typical ordering of functors (short sounds) come before the content words (long sounds) in English, so an English speaker exposed to this linguistic pattern all of their life may be biased to group short-long sequences in all of auditory perception

(including the non-linguistic sequences of tones used in this experiment). The opposite (long-short) pattern typical of the Japanese language may bias Japanese speakers in the exact opposite way accounting for the difference and cultural bias discovered by the experiment.