Spoken Nursery Rhymes Have a Fractal Rhythmic Structure - Evidence from Patterns of Slow Amplitude Modulation (AM)

Victoria Leong
University of Cambridge, Department of Experimental Psychology, Centre for Neuroscience in Education

Richard Turner
University of Cambridge, Department of Engineering, Computational & Biological Learning Lab

Michael Stone
University of Cambridge, Department of Experimental Psychology, Auditory Perception Group

Usha Goswami
University of Cambridge, Department of Experimental Psychology, Centre for Neuroscience in Education

Abstract: Children's knowledge of nursery rhymes predicts later phonological and reading skills (Maclean et al, 1999). This developmental relationship may be mediated by rhythmic and prosodic structure: nursery rhymes have been described as perfect metrical poems. Here we investigate the hypothesis that nursery rhymes are rhythmically fractal. 27 nursery rhymes were spoken in a rhythmic or non-rhythmic ('reporting') style by 5 speakers. The speech envelope from each sample was passed through a low frequency (0-50 Hz) 8-channel amplitude modulation (AM) filterbank and channels were analysed for temporal patterning. For rhythmically-spoken rhymes, modulations in adjacent channels were strongly phase-locked so that one modulation cycle in a given channel typically encompassed two full cycles in the next channel. This phase-locked pattern extended across multiple modulation frequencies resulting in a hierarchically-nested, fractal structure. Non-rhythmic samples showed lower phase-locking. The fractal temporal structure of rhymes may serve to optimally entrain neural oscillatory activity for rhythm detection.