Feeling the Beat: Movement Influences Infant Rhythm Perception

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We hear the melody in music, but we feel the beat. People in all cultures move their bodies to the rhythms of music, whether drumming, singing, dancing, or rocking an infant (1). Body movement involves motor, proprioceptive (perception of body position), vestibular (perception of movement and balance), visual, and auditory systems (2), but few studies have examined auditory-vestibular interactions.

The ability to feel and interpret the strong and weak beats in a rhythm pattern allows people to move and dance in time to music. Typically, the strong beats of a rhythm pattern are played louder, longer, or both, and the metrical structure (what you move to) is derived from, and consistent with, these physical accents (3). However, in an ambiguous rhythm pattern with no physical accents, different movements might give rise to different metrical interpretations. In other words, how we move may influence what we hear.

We tested the hypothesis that movement influences the auditory encoding of rhythm patterns in human infants. In experiment 1, we trained 7-month-olds by having them listen to a 2-min repetition of an ambiguous (without accents) rhythm pattern (Fig. 1A, row 1, and sound file S1). Half of the infants were bounced on every second beat, and half on every third beat. After training, infants’ listening preferences were tested for two auditory versions of the rhythm pattern, which included intensity accents on either every second beat (the duple form) or every third beat (the triple form) (Fig. 1A, rows 2 and 3, and sound files S1 and S3). Infants controlled how long they listened to each version of the rhythm pattern in a head-turn preference procedure (4).

In order to confirm that the movement itself did not induce auditory accents due to changing room acoustics as the subjects moved, we trained a group of adult listeners with headphones. Those who bounced (mimicking a model) on every second beat during training identified the duple form as familiar at test, whereas those who bounced on every third beat identified the triple form. Finally, we tested infants’ preferences without any movement training and found no preference for either auditory interpretation, again indicating that movement is crucial for the multisensory effect.

These studies illustrate the strong multisensory connection between body movement and auditory rhythm processing when inputs from both sources are experienced concurrently. Because infants did not engage in self-movement, the observed effect likely involves the vestibular and perhaps proprioceptive systems. The early development of the vestibular system (5), and infant delight at vestibular stimulation when bounced to a play song or rocked to a lullaby, suggest that we are observing a strong, early vestibular-auditory interaction that is critical for the development of human musical behavior. It has long been known that infants are attracted to music and responsive to its emotional content (6, 7). Our findings provide evidence that the experience of body movement plays an important role in musical rhythm perception.

References and Notes
4. Materials and methods are available as supporting material on Science Online.
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Supporting Online Material
www.sciencemag.org/cgi/content/full/308/5727/1430/DC1
Materials and Methods
References and Notes
Sound Files S1 to S3

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