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So you think you can't dance? (The mysterious case of the guy with two left feet)

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Reviewed by:

Leo
8 years old

Got rhythm? Most of us do – at least a little bit. Believe it or not, even babies can feel the beat of a rhythm [1]. However, science has documented the first case of a person who could not dance to the beat. His name is Mathieu, and he is an intelligent, talented – even *musical* – guy with no other known brain problems, except, he cannot find the beat in music.

Mathieu did not just suddenly come to realize this problem, and he did not give up easily. He spent most of his 23 years of life studying music (various instruments, voice) and dance (Latin dance lessons, and he even performed in a dance troupe at a family amusement park!), only to find, time after time, that he could not keep up with the musical beat. When he attended concerts with his friends, everyone clapped along in time while watching the musicians on stage, Mathieu turned to watch his friends, in an attempt to clap in time *by watching them*. He sought help from his friends and private tutors, and sometimes just threw his cares away and danced publicly with his friends. Still, there seemed to be no remedy for his deficit.

So what was wrong? A group of music neuroscientists tracked down Mathieu (using advertisements that said *"Do you have no rhythm? Have two left feet? Do you think you can't dance?"*) and brought him to the laboratory to find out what might be the problem. The task they gave Mathieu – and 33 dancers who reported no rhythm problems – was to listen to a popular Latin dance song, of the merengue style, and to simply bend at the knees and bounce to the beat. In order to measure the timing of Mathieu's bounces, they used a commonly known device for capturing motion data: the remote control of the Nintendo Wii (Figure 1). Why did they use a Nintendo Wii to capture the body movement? Because, with an accelerometer inside the Wii, this instrument recorded the periodicity of Mathieu's bounces, down to the level of 10 ms – information which the researchers stored for analysis. They then compared the periodicity of Mathieu's bounces with the period – also known as *tempo* – of the Latin music. If Mathieu could feel the rhythm of the merengue, then his body movement would have a periodicity similar to the music's tempo. Furthermore, if he really moved in time with the music, then his body motion would be phase locked to the musical beat – that is, when his knees would finally hit their lowest point ("bam!"), that point would coincide precisely with the thump of the musical beat (think: bass drum). When this happens, we can say that we are "synchronized" or in rhythm with the beat.

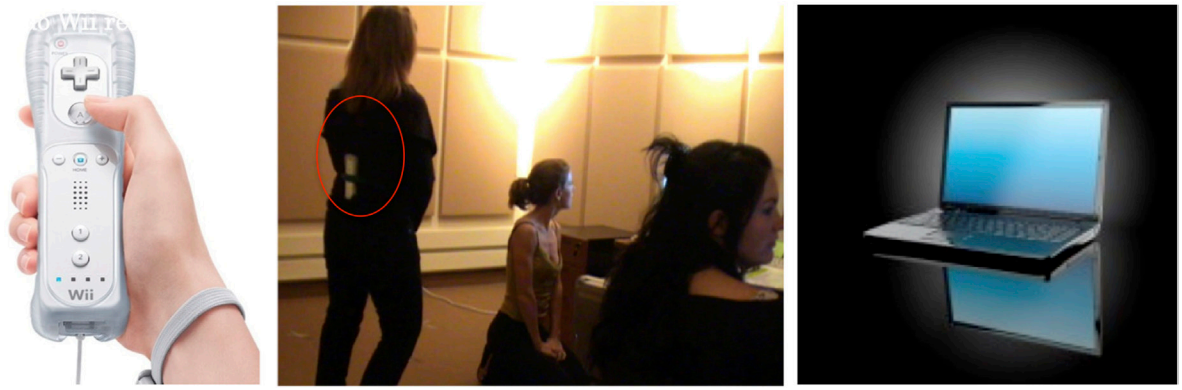

FIGURE 1 - Using the Nintendo Wii for data capture.
The accelerometer inside the remote control of the Nintendo Wii tracks the downward acceleration of the bouncing subject and records it onto a computer for analysis of the beat period and phase.

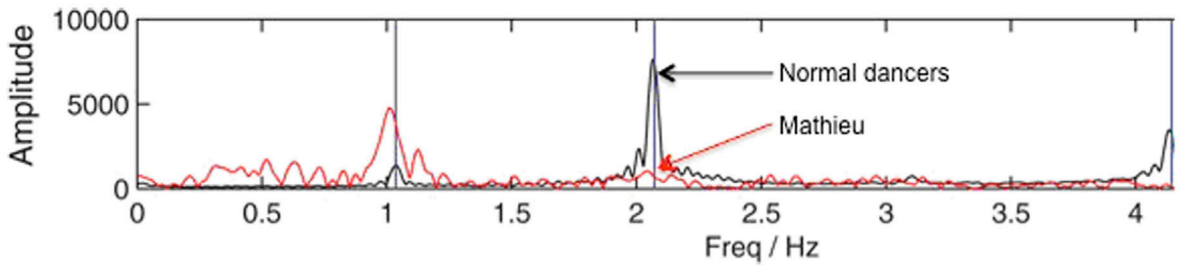

FIGURE 2 - How much did Mathieu and normal dancers bounce on the beat of the Latin merengue music?
The bouncing data are represented as the amplitude of motion for Mathieu (red line) and normal dancers (black line). The vertical lines (blue) indicate the musical half-beat, beat, and twice-beat frequencies (approximately 1, 2, and 4 Hz, respectively). The middle blue line (at 2 Hz) shows the merengue tempo (corresponding to the quarter-note beat). While the normal dancers' amplitude of motion has a primary peak at the musical beat (2 Hz) and a secondary peak at half the musical beat (4 Hz), Mathieu's does not have either (the energy that Mathieu's motion shows at twice the musical beat frequency (1 Hz) did not reach significance).

The 33 normal dancers were able to synchronize their movement (in period and phase) with the beat of the music, which we can see when we look at their amplitude – or amount – of motion. It should "peak" at the musical tempo (see the black curve peak at 2 Hz, or 2 beats/s, in Figure 2). This means that most of their energy of motion is happening at the musical beat.

On the other hand, Mathieu did not show a peak energy in his motion at the musical beat (see the red curve, with no peak on the beat). In fact, he showed almost no energy at all on the musical beat! Instead, his energy of motion was spread out across a range of frequencies or tempo. And if you do not put energy of motion into the musical tempo, then you definitely cannot be in rhythm with the beat. In other words, the normal dancers "synchronized" their bouncing to the musical beat, while Mathieu did not.

The researchers wanted to rule out the possibility of a simple inability to maintain a steady movement tempo (for example, a motor problem), so they had the subjects bounce in time to a metronome as well. This control condition showed that Mathieu and the others could maintain movement to a steady beat – just, in Mathieu's case, not in the context of music (want to see

video animations of Mathieu and a normal participant bouncing to the merengue versus the metronome? Go to: www.brams.umontreal.ca/short/beatdeaf/).

The researchers also wanted to make sure that Mathieu was not just "deaf" to the beat of Latin merengue music. So they asked Mathieu to bounce to a whole range of musical styles and tempos: pop, lounge, techno, swing, even Egyptian belly dance music. Some were more rhythmically complex than others – for example, the techno music had the simplest and clearest beat. The only piece in which Mathieu was able to grasp the musical beat was the techno music, and the researchers thought that it was because the techno piece was not much more complex than a metronome! So, hypothetically, could Mathieu dance to a simple drum rhythm? The researchers think he might – the only thing that we still have to figure out is: exactly how "simple" does the rhythm have to be? That's just the kind of questions that future studies can uncover.

The researchers concluded that Mathieu had a musical disorder – probably from birth – and they called it "beat deafness." If beat deafness is similar to "tone deafness" (another musical disorder), then it might have a genetic basis – one way to find out would be to see if others in Mathieu's family share this disorder. Finding more cases like Mathieu's will help to illuminate the brain basis for beat deafness, and this will even help scientists to better understand how normal people hear – and feel – the beat of music. For example, if researchers discover that people like Mathieu have trouble connecting what they hear (the drum beat) with how they move (their dancing), then that can help them solve the puzzle by demonstrating that normal people do form a connection between what they hear and what they feel in music.

You might wonder whether there is any cure for beat deafness. If there is, then the best bet would be to try to catch it early on in childhood. Remember, even babies "feel the beat." So what if a kid discovers a problem with following the beat of music before the age of 12? If scientists can find a way to measure it, then they might find a way to treat it – most likely with some careful guidance and a lot of practice.

Are we, humans, the only animals that can move to the beat of music? You might be surprised to learn that we are not, and the reason could boil down to the brain's ability to learn to imitate and to acquire new sounds using the voice. For example, some birds find a groove [2] (for the most famous example, see Snowball, the Backstreet Boys-loving sulfur-crested Cockatoo[1]). However, recently, a sea lion burst onto the dancing scene, which is not an example of vocal mimic (that is Ronan, the disco-dancing pinniped[2]) [3].

Dancing might simply be a part of evolution's way of favoring certain kinds of communication, that is, *if* you have got the rhythm.

So, you think you can dance now?

[1] www.youtube.com/watch?v=N7IZmRnAo6s
[2] www.youtube.com/watch?v=6yS6qU_w3JQ

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REVIEWED BY:

Leo, 8 years old

I am 8 years old and I live in Carmel, IN, USA. I like airplanes, books, space, science, technology, mathematics, and travel. I enjoy listening to music (especially classical and jazz) and playing piano. I hope to play an organ in the hall where Indianapolis Symphony plays. I like to read adventure books and play tennis. When I grow up, I want to be a scientist, pilot, or inventor working on new airplanes and spaceships.

AUTHOR

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My greatest passions are for studying the mind, music and dance, yoga, and discovering self-actualization. Following these passions is my life's journey. Now I have a child of my own, and watching her young mind grow is the greatest discovery of all. For me, being part of the team at Young Minds means surrounding myself with people of all ages who are curious and creative, analytical thinkers, and who care about the future of humanity. Our Young Minds hold the power to change the world, and I want to see it happen!