

Study reveals methods used by musicians to stay in tempo with each other

January 29 2014, by Bob Yirka



Philharmonic Orchestra of Jalisco (Guadalajara, Jalisco, Mexico) Credit: Pedro Sánchez/Wikipedia

(Phys.org) —A team of researchers with members from the U.K. and Germany has found that musicians playing in a string quartet keep time with one another in two distinctly different ways. One, way, the team explains in their paper published in *Journal of the Royal Society: Interface*, is to play follow-the-leader—everyone adjusts their tempo to

one leader. The other way is far more democratic—all of the players constantly change their tempo to keep time with everyone else.

In watching and listening to a string quartet, it generally seems as if all they players have an internal metronome—they all seem to keep perfect time with one another without having to make adjustments. In reality, players must make adjustments all the time, at least most of them.

Different kinds of music require different types of tempo control—rock and pop music follows the percussionist—generally the drummer. Orchestras rely on a maestro with a baton to maintain a steady pace. String quartets, on the other hand, have no set leader, so, how do the players maintain a steady tempo?

To find out, the researchers enlisted the assistance of two highly skilled quartets—each had a tiny microphone placed on their instrument which was able to record just the instrument to which it was attached. All of the sounds from each of the four instruments was sent to a computer which was able to not only compile the music into its traditional quartet format, but was also able to track the individual tempo for each instrument and compare it with what was occurring with the other instruments.

In analyzing the results, the researchers found it became very clear how tempo was maintained. For one quartet, three players varied their tempo to match the fourth, who never varied hers. Thus, the group had a leader that served very much like a drummer in a rock band. In the other quartet, however, there was no leader, thus all four players were found to continually adjust their tempo to match that of the other three players. Players in both quartets claimed they didn't realize that they were adjusting their tempo and didn't realize that some groups have a leader while others are more democratic in their technique.

What's not clear is whether one approach produces superior music quality—the researchers next plan to find out by having different quartets perform for small audiences which can then be queried regarding the quality of the [music](#) as they perceive it.

More information: Optimal feedback correction in string quartet synchronization, Published 29 January 2014 [DOI: 10.1098/rsif.2013.1125](#)

Abstract

Control of relative timing is critical in ensemble music performance. We hypothesize that players respond to and correct asynchronies in tone onsets that arise from fluctuations in their individual tempos. We propose a first-order linear phase correction model and demonstrate that optimal performance that minimizes asynchrony variance predicts a specific value for the correction gain. In two separate case studies, two internationally recognized string quartets repeatedly performed a short excerpt from the fourth movement of Haydn's quartet Op. 74 no. 1, with intentional, but unrehearsed, expressive variations in timing. Time series analysis of successive tone onset asynchronies was used to estimate correction gains for all pairs of players. On average, both quartets exhibited near-optimal gain. However, individual gains revealed contrasting patterns of adjustment between some pairs of players. In one quartet, the first violinist exhibited less adjustment to the others compared with their adjustment to her. In the second quartet, the levels of correction by the first violinist matched those exhibited by the others. These correction patterns may be seen as reflecting contrasting strategies of first-violin-led autocracy versus democracy. The time series approach we propose affords a sensitive method for investigating subtle contrasts in music ensemble synchronization.

[Press release](#)

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