

# How players strike keys depends on how muscles are used for keystrokes that occur before and after

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Researchers have long been aware of a phenomenon in speech called coarticulation, in which certain sounds are produced differently depending on the sounds that come before or after them. For example, though the letter n is usually pronounced with the tongue pressed near the middle of the mouth's roof (as in the word "ten"), it's pronounced with the tongue farther forward when it's followed by -th (as in "tenth"). A decade ago, researchers discovered that this phenomenon extends to a different kind of communication, American Sign Language. Knowing that hand movements could be affected according to where they fit in during sign language, researchers wondered if there was a similar effect on hands when they were used to produce sound, such as playing the piano.

To help answer this question, Martha Flanders and her colleagues at the University of Minnesota collected detailed data on the [muscle movements](#) of piano players, both amateurs and professionals. Their findings suggest that piano playing indeed involves coarticulation, with hand muscle contractions differing depending on the sequence of notes played.

The article is entitled "Patterns of Muscle Activity for Digital Coarticulation." It appears in the *Journal of Neurophysiology*, published by the American Physiological Society.

## Methodology

The researchers recruited 10 healthy piano players, four of whom played professionally and the rest amateurs with a range of experience on this instrument. These volunteers were all asked to play only the right-handed notes of 14 different excerpts from 11 different musical pieces from composers including Chopin and Bach. These pieces were chosen specifically because of their use of the right hand and the large number of notes in which the preceding and subsequent keystrokes were performed by other fingers.

While these subjects played, the researchers collected a variety of data, including the force of keystrokes, how closely the subjects adhered to the timing set by a [metronome](#), as well as [muscle activity](#) recorded from electrodes placed on the skin of subjects' right hands. The researchers collected activity readings from muscles that both extend and flex the thumb and all four fingers.

## Results

When the researchers analyzed their data, they found evidence suggesting that piano players indeed exhibit coarticulation in their finger movements while playing. The muscle activity they recorded showed that the way players strike keys depended on the nature of keystrokes that occurred before and after.

## Importance of the Findings

These findings suggest that, like practitioners of American Sign Language, piano players' hand movements depend on other movements in a sequence. Still unknown, the authors say, is how closely the muscle activation commands in the spinal cord are dictated by activity in the

cerebral cortex.

"This phenomenon may or may not be accompanied by coarticulation at the level of the motor cortex," they write.

**More information:** [jn.physiology.org/content/earl ...  
3.2012.full.pdf+html](https://jn.physiology.org/content/earl/3.2012.full.pdf+html)

Provided by American Physiological Society

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