Neuromuscular patterns of finger movements during piano playing. Definition of an experimental protocol

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SUMMARY

Body movements require the activity of muscles fired by their motor neurons, controlled and coordinated according to central motor patterns modulated by the sensory feedback. The direct analysis of movements and forces produced by muscular activity can provide useful information into anatomical details of difficult observation. For instance, the analysis of movement trajectories can be used to obtain some insight into the underlying neuromuscular processes.

Piano playing is a learned ability which links natural hand and finger movements in a complex and well-codified pattern. In the present study, the repeatability of finger movements was assessed in pianists of different experience.

Five pianists (two females, 9, 23 years; three males, 24, 39, 70 years; all professionals) played nine two-octave C-major scales at 80, 112 and 160 bpm. The three-dimensional coordinates of their right hand fingers were digitized by a motion analyzer. For each pianist, data from each of the three repetition performed at the same velocity were aligned on the time of onset of the first C keypress (thumb), and a coefficient of superimposition was computed.

Significant (analysis of variance, $p<0.001$) differences were found between pianists and velocities, with a significant pianist x velocity interaction. The oldest man (a well-known concert player) was the less repeatable (mean superimposition 65.8%, SD 17), the 39-y-old man (a piano teacher) was the most repeatable (mean superimposition 81.4%, SD 8.1). In both of them, the thumb was the most repeatable finger; in the girl, the fifth and fourth fingers scored the best repeatability. The fastest scales were the less repeatable in the 70 and 24-y-old men, and the most repeatable in the 39-y-old man and 23-y-old woman.

Even a simple and basic piano exercise can be performed with different movement patterns, without a direct relationship to the pianist experience. Apparently, repeatability was lower in concert pianists than in teachers and learners.