Research Topics

MAX PLANCK INSTITUTE FOR THE HISTORY OF SCIENCE

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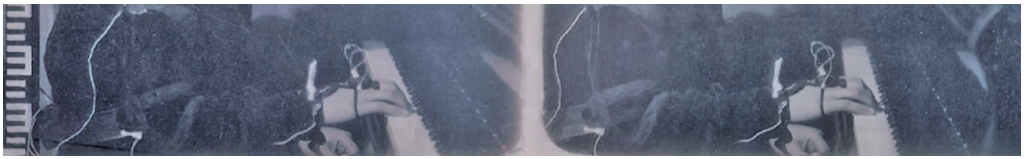


The Physiology of the Piano – Keystroke Experiments During the 1920s

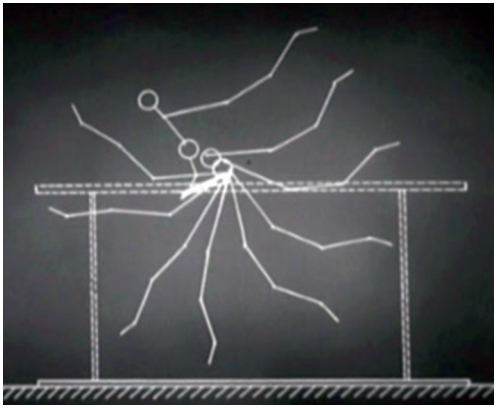
The Moscow Neurophysiologist Nikolai Bernstein Brought Piano Virtuosos into the Laboratory

By Julia Kursell

The piano emerges as an arena of scientific experiment around 1900. The focus of experimentation was not the sound produced by the piano, but rather the individual playing it, with the muscle tension, metabolism, and the bearing of piano performers capturing the interest of experimental physiologists.

Piano music's popularity during the nineteenth century was without precedent. Piano virtuosos were celebrated in concert halls across Europe, as the piano became the consummate symbol of the music culture of the strengthening middle classes. A tool for composers, the piano also served as a teaching aid at music conservatories. For the Russian neuroscientist Nikolai Bernstein, piano playing was as an almost ideal object of research. In Bernstein's investigations, piano music emerges as a site for the creation of knowledge about the human body.

Bernstein conducted his research on motion control in piano playing at the Moscow State Institute for Musical Science. His interest lay in virtuoso performance. A virtuoso pianist was one who had mastered the performance of parallel octaves, a piano technique introduced by Franz Liszt. Piano instructors at the time, however, were unable to teach students the tech-



Bernstein's method for the registration of bodily movement (excerpt from the film "The Scientific Foundations of Athletics", newsreel Soviet Athletics, Nr. 6, I. Venzher, director, N. Vikhirev, camera, TsSDF 1948). The film is available online.

nique. Their advice to students was to appropriate the correct movement at a slow pace, and then to accelerate gradually once the movement had been mastered. Those who followed this method were however soon complaining of physical discomfort. Fast parallel octaves are beyond the ability of many pianists. Risky, loud, and clearly visible, they were, as they are now, a hallmark of a true virtuoso. The entry of parallel octaves in the last movement of Tchaikovsky's piano concert in B-flat minor, for example, is staged nearly as dramatically as the appearance of a new circus act. (A Listening sample from Pyotr Ilyich Tchaikovsky's Piano Concerto No. 1 in B-flat minor, Op. 23, 3rd movement with Vladimir Horowitz; Arturo Toscanini; NBC Symphony Orchestra (Carnegie Hall 1941) is available online).

In 1926, Bernstein was invited to the State Institute for Musicology to solve the riddle of the parallel octaves. Together with piano experts at the State Institute, Bernstein developed a method to capture the many detailed movements of the octave performance. His decisive innovation was to equip a device recording the pianist's movements with a moving celluloid film, attaching small light bulbs to the performer's arm. As the pianist's arm moved up and down, the light from each bulb produced a curve on the moving celluloid film. In front of the camera lens Bernstein and his colleagues mounted a rotating perforated disk. At regular intervals this disk interrupted each lamp's incidence of light, thereby reproducing the course of the performer's movements over time.

The resulting curves were then subjected to careful mathematical analyses. These analyses revealed that the fast parallel octaves were produced by a forced vibration that can only be made at a fast pace, prompting the hand to swing like a simple pendulum. This economy of movement can only be achieved when the pianist no longer attempts to guide the motion, but rather allows the hand itself to perform the act.

Bernstein later applied this method to record and decode human movements to the study of feedback mechanisms in motion control. His achievements to a number of fields of human endeavor, including but not limited to prosthetic and sports medicine, earned him the Stalin Prize. However, when in 1950 Pavlov's doc-

Stereoscopic photograph of a wired pianist, Moscow 1925, courtesy Andrei Smirnov.

trine of the reflex arc was declared Soviet doctrine, Bernstein was exposed to reprisals. Forbidden to work, Bernstein was not officially rehabilitated until shortly before his death in 1966.

Research on the interconnections between musical aesthetics and experimental science is a focus of the Dilthey-Fellowship "Epistemology of Hearing 1850-2000." Investigations conducted at the State Institute for Musical Science in Moscow are the focus of the sub-project entitled: "The Experimentalization of Hearing, Moscow 1920-1930." In the many institutes established during the first years of the Soviet Union, experimental research was conducted on a range of aesthetic questions advanced by advant-garde artists and theorists. During this period, the Moscow Institute for Musical Science addressed such issues as perceptions of tone pitch and rhythm, musical talent and absolute pitch, as well as piano and song pedagogy.

As reflected in Bernstein's work on piano playing, constellations of knowledge and aesthetics captured the imagination of both artists and scholars. Piano music continues to provide experimental science new avenues of research; by the same token, science offers musicians and composers inspiration. A series of events presents these interconnections to public audiences. Entitled "Physiology of the Piano: Lectures and Concerts on Music in the History of Science", it brings together not only historians of science and musicologists but also composers, physicians, pedagogues, philosophers, and, quite naturally, the pianists themselves. Drawing on the example of piano music from such diverse composers as Johann Sebastian Bach, Frédéric Chopin, John Cage, and Marco Stroppa, among others, we discuss the intersections of acoustics, psychology, motor skills, and aesthetics. On May 13, 2009, Swiss composer Edu Haubensak will present his compositions for alternative tuning systems. Haubensak's performance will be supplemented by Wolfgang Auhagen's presentation on instrumental tuning. On June 10, 2009, our Institute will devote

another evening to the subject of practice, with elucidation in word and sound from music physiologist Hans-Christian Jabusch and pianist Ragna Schirmer.

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