Music, physics, mathematics and psychoacoustics. How to apply our knowledge about science in music education.

Presentation by dr. hab Rafał Sarnecki (Academy of Music in Lodz)

Abstract

The purpose of the lecture is to present how the knowledge about psychoacoustics and the science of sound can be helpful in understanding such elements of music as: dynamics, articulation, tuning or harmony. This knowledge could be useful for performers, composers but also music educators. Musical concepts presented in a classroom situation can sound more convincing when supported by scientific facts and examples.

The first topic which will be discussed is the articulation in music performance. One of the most important aspects of the articulation is the duration of a note. Experiments show that for relatively short acoustic signals the subjective duration is significantly different than the physical duration. Human ears naturally perceive notes as longer than rests which has huge consequences for articulation and rhythm.

Psychoacoustics helps us also understand how we perceive dynamics in music. Experiments prove that our ears have significantly weaker frequency selectivity for stronger acoustic signals. This has large consequences for our perception of sound during the rehearsals and the way we balance our instrument volume with other musicians. Our perception of loudness is not proportional to the intensity of the sound wave. This affects how we execute dynamics during music performances.

The theory of harmony is based on mathematical relations between frequencies of notes. All the intervals, chords and scales can be described using numbers. Being aware of those mathematical relations can be useful when tuning an instrument. It can also help us understand the basics of music theory, how the scales and chords developed and why some of them sound more dissonant than the others.

Mathematics is also useful when dealing with note permutations, interval permutations or motive transformations. Those could be of interest for both improvisers and composers when creating new melodic lines or developing melodies.

Rafał Sarnecki

Rafał Sarnecki - guitarist, composer, arranger born in 1982 in Warsaw, Poland. In 2005 he left his hometown to study jazz in New York where he spend most of his career. Living in NY he was involved in a variety of New York based groups including: Lucas Pino No-Net Nonet and Annie Chen Group. He has shared stage with such artists as: Ron Blake, Ingrid Jensen, Alex Sipiagin, Ben Wendel, Joel Frahm. He has recorded four CDs featuring his compositions.

Rafal received a MS degree in physics from the Warsaw University. Living in NYC he received a BFA degree from the New School and MA degree from the CUNY Queens College. In 2015 he received a Ph.D. in composition from the Fryderyk Chopin University of Music in Warsaw.

Currently Rafal is living in Warsaw. He is an associate profesor at the Grażyna and Kiejstut Bacewicz University of Music in Łódź.