

A Microcosm of Musical Expression, Part I: Quantitative Analysis of Pianists' Timing in the Initial Measures of Chopin's Etude in E Major

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Introduction

- Musical expression is often exercised within bounds
 - Notated instructions
 - Rules and conventions
- Piano-specific constraints:
 - Variation in timing, dynamics, articulation
 - No vibrato, less envelope control, etc.
- Measurement techniques for piano:
 - Audio recordings
 - Only horizontal timing and dynamics can be reliably measured
 - Can represent best artists over many decades
 - MIDI recordings (not used in this study)
 - More robust and complete measurements possible
 - Limited to current-day artists


Objectives

- Perform a controlled, objective analysis of expressive performance
 - Limit scope
 - Length of audio analyzed
 - Note: shorter passages often yield more observable diversity of individual performances
 - Number of expressive parameters
 - Piano is naturally constrained
 - Use large sample size
 - Variety of artists
 - Range of performance types

Objectives

- Understand expressive strategies
 - Are they categorically distinct?
 - Or do they form a continuum of possibilities?
- Investigate relationship between expressive performance and the following sociocultural variables:
 - Age at time of recording
 - Birth date
 - Recording date
 - Gender
 - Nationality

Approach

- Selected passage:
 - First 5 measures of Chopin's Etude in E Major 
 - Melody invites large deviations
 - Many recordings
 - Convenient to measure
 - Employed in author's previous research
- Selected recordings:
 - 115 total, 102 from International Piano Archives
 - Span 68 years, many nationalities

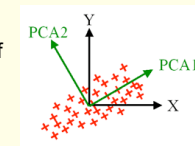


Approach

- Measurement
 - Used visual/auditory cues to locate onsets
 - 38 event onsets -> 37 inter-onset intervals (IOIs)
 - Assumed causes of measured variations:
 - Largely due to expression
 - Measurement error
 - Pianists' motor control limits
 - Single "timing profile" generated per recording
 - Contains 36 IOIs
 - Upbeat treated separately

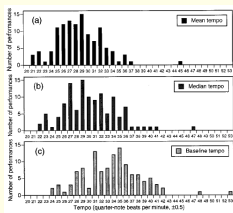
Approach

- Principal component analysis (PCA)
 - Method of dimensionality reduction
 - Accounts for most data variance with fewest dimensions
 - Each timing profile may be approximated by a weighted sum of principal component (PC) profiles
 - Varimax rotation modifies PCs by the following criteria
 - Maximize no. of profiles similar to particular PC
 - Minimize no. that are similar to more than one PC



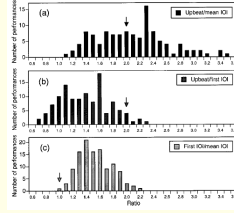
Results

- Three aspects of expressive timing
 - Basic tempo
 - Distribution of tempi approx. normal
 - Relative modulation depth
 - Significant correlation between avg IOI and IOI std dev for individual performances
 - Insignificant with "relative mod. depth" measure
 - Profile shape



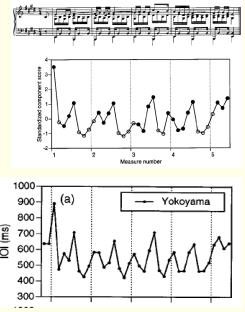
Results

- Initial upbeat observations:
 - Wide range of values of upbeat IOI relative to mean IOI
 - First IOI tended to be lengthened relative to mean IOI



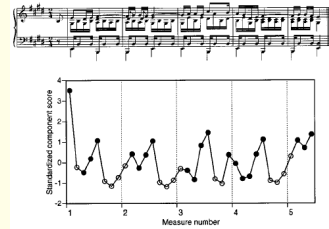
Results

- Profile shape
 - PCA results
 - First PC accounted for 61.4% of data variance
 - First 4 PCs for 75.9% of variance
 - Remaining 24.1% considered unexplained
 - Idiosyncratic intentions
 - Lack of timing control
 - Measurement error



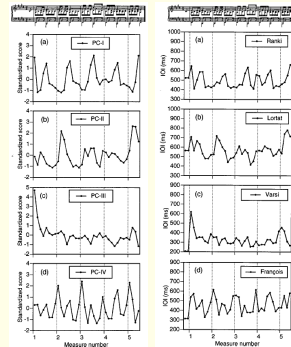
Results

- Analysis with first unrotated PC (UPC-I)
 - Most performances fairly similar to average
 - Lengthening tendencies are a complex function of all structural features, including melodic grouping



Results

- Profile shape: analysis with rotated PCs
 - PC-I
 - Accounts for most variance: 31.3%
 - "Single most common strategy" as opposed to most typical mixture of strategies
 - Emphasizes within-segment ritards
 - Located at ends of melodic groups
 - Possibly reflects metrical strength or melody/accompaniment separation
 - PC-III
 - High correlations possibly result of very large value shared by two data sets



Results

- Profile shape: additional observations
 - Many timing profiles loaded nearly equally on more than one PC
 - Suggest a combination or alternation of strategies
 - Independent timing patterns (PCs) can be found across different pianists
 - Timing patterns of individual gestures tend to be consistent (within PCs)

Results

- Similarity among performances
 - Correlations higher than 0.93 were not found
 - Correlations higher than 0.99 corresponded to identical performances (plus measurement error)
 - Individual timing patterns for the same music can change significantly over time

Results

- Sociocultural Variables
 - Type I timing is more common, and Type II timing is less common in recent years
 - Type IV patterns may be more common in younger generations
 - Older artists may exhibit more unusual timing patterns
 - Men tend to play longer upbeats than women
 - Women tend to play faster than men

Discussion

- Large sample analysis revealed a continuum of aesthetically acceptable timing patterns
 - No distinct clusters existed
- PC patterns may be seen as a basis from which individuality, motion, and affect may be expressed in a given musical structure
- Inexperienced pianists tend to play with conventional timing profiles
- Todd's acceleration/deceleration model does not characterize the majority of timing profiles in this study
- Sociocultural correlations were generally not strong and require additional analysis

The End

- Questions?