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A microcosm of musical expression. I. Quantitative analysis of pianists' timing in the initial measures of Chopin's Etude in E major

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In this paper, Bruno Repp presents the results of a principal component analysis of expressive timing patterns of the first 5 bars of 115 commercially recorded performances of Chopin's Etude in E major, op. 10, no. 3. He states that the goal of objective performance analysis such as this is to be able to determine the extent to which performances are similar or typical. Quality of performance remains a subjective matter of taste.

The author chose this particular musical passage for several reasons. First, it represents one of Chopin's most beautiful melodies and invites large deviations in timing in the service of expression. Second, due to the popularity of the piece, there exist many recordings to analyze. Third, the passage has a slow tempo and an underlying sixteenth-note structure which makes it convenient for analysis. Finally, the author was also able to build on some of his previous studies which utilized the same passage.

The recordings were input as analog signals into a computer using a sampling rate of 20.055 kHz. The resulting waveform was then analyzed to locate onsets of individual sixteenth notes. Inter-onset intervals (IOIs) were calculated by measuring the distance in milliseconds between successive onset events. The complete set of IOIs for a given recording constituted that pianist's timing profile. The timing profiles were subject to a principal component analysis in which a small number of completely independent principal components (PCs) were calculated such that each individual profile could be approximated by a weighted sum of the PCs. The PCs were further subjected to a Varimax rotation which altered the PCs in order to maximize the number of actual timing profiles that were similar to a particular PC and minimize the number that were equally similar to several PCs. Because the PCs were calculated using standardized timing profiles, attributes such as basic tempo and IOI variability were analyzed separately.

The analysis yielded 4 significant PCs. These were interpreted as 4 independent timing strategies employed in uniquely weighted combinations by each pianist. The four strategies were interpreted to be: 1. major ritards at the ends of melodic gestures; 2. acceleration within some of these gestures without final ritards; 3. extreme lengthening of the initial downbeat; and 4. ritards between as well as within melodic gestures.

In discussing the results, Repp notes that the various performances represented a relatively continuous sampling of the different possible performances. The fact that there was not a distinct clustering or grouping of timing patterns suggests that individual differences in timing did not arise from contrasting interpretations of musical structure. I appreciated Repp's acknowledgment that musical expression is not necessarily about conveying musical structure, but that ultimately it is about moving listeners and stimulating their imagination.

Overall, Repp presents an interesting and successful method of objective performance analysis. He achieves the goal of finding an objective way to determine the similarity of two performances. In this case, statistical correlation between different timing profiles allows for a quantitative measure of timing similarity. To his credit, Repp exercises caution in drawing conclusions from his analysis, noting that the four timing patterns represented by the PCs are descriptive tools and no more. Whether they have any psychological manifestation is uncertain. I would predict that none of the pianists were aware of the PCs that made up their performances. What the PC analysis does demonstrate is that certain overall timing patterns (different PCs) are independent of each other while other patterns (those within a given PC) often go together.