

The Role of Orchestral Gestures in Continuous Ratings of Emotional Intensity

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ABSTRACT

Background

Despite its increasingly important role in compositions in the late-nineteenth and twentieth centuries, timbre has not been theorized in music research to the same extent as other parameters such as harmony, melody, rhythm and formal processes. In general, orchestration manuals provide prescriptions for instrumental combinations and short excerpts to be emulated (Sandell 1995).

Empirical studies suggest that timbral changes induce emotional responses in listeners. Guhn et al. (2007) reported that listeners experienced chills during musical passages marked by the alternation or contrast of a solo instrument and the orchestra. Panksepp (1995) found that participants experienced chills when a soloist emerged from a dense orchestral texture. Tears, chills, and an increase in heart rate were associated with sudden dynamic or textural changes by Sloboda (1991).

Orchestration treatises allude to these large-scale instrumental gestures, but a clear taxonomy of techniques and a conceptual framework related to their function and perceptual effect is still lacking.

Aims

In this paper we use two approaches to investigate how emotional responses to large-scale orchestral gestures unfold in time in relation to other musical parameters. First, we use a time series regression study to predict changes in emotional response by modeling changes in musical features (such as loudness and tempo). Second, we advance a new type of visualization that both illustrates the relative textural density of each instrumental family over time and maps musical-feature overlays of time-varying musical parameters.

In this exploratory study our first aim is to model one aspect of the temporal dynamics of the listening experience by investigating the musical features in orchestral music that elicit emotional responses. Additionally, we aim to contribute to the development of a theory of orchestration gestures through music-theoretical analyses and findings from the behavioural study.

To our knowledge, this study is among the first to isolate various timbral changes in relation to musical structure and to explore their potential affective responses.

Method

As a starting point for inquiry, we constructed four categories of *orchestral gestures* based on large-scale instrumentation changes that vary in terms of time course (gradual or sudden) and direction (addition or reduction).

Twelve musical excerpts were chosen to fit within the four categories (three excerpts per category). The excerpts were

categorized by only one overarching orchestral gesture. Drawn from the orchestral repertoire of the late-nineteenth and early-twentieth century (e.g., works by Mahler, Bruckner, Debussy, Strauss), the excerpts were 1-3 minutes in duration in order to provide a listening context. Well-known excerpts were avoided to ensure that participants responded to the musical stimulus itself and not to external associations.

In group listening sessions, 45 participants (22 musicians and 23 non-musicians) listened to the excerpts in randomized order and continuously moved a slider to indicate the buildup and decay of the intensity of their emotional responses. The slider was equipped with an elastic band to provide force-feedback, which we have found to be an intuitive method of rating that obviates the need for visual attention to the rating device. Participants also completed questionnaires outlining their specific subjective experiences (chills, tears, and other reactions) and their familiarity and preference for each excerpt. These latter data will be analyzed in a later study.

Musical feature variables were coded as time series to be used in the visualizations and as predictors of the behavioural ratings in the regression analyses. Four features (loudness, spectral centroid, tempo, and instrumental texture) were selected based on their importance in other regression models (Schubert 2004) and in descriptions of orchestral gestures in treatises (Adler 2002). In addition to the total count of instruments used in the regression analysis, the texture parameter was also expanded for the visualizations to include the contributions of each instrumental family: strings, woodwinds, brass, percussion, and organ/harp.

Results

Following Schubert (2004), we conducted two linear regression models of the musicians' and non-musicians' emotional responses for each of the excerpts. All of the autoregressive models have significant coefficients, but only a small portion of the variance can be explained. Similar to Schubert's (2004) findings, tempo and loudness were the main musical features included in the regression models. Spectral centroid contributed to the emotional intensity ratings for the sudden reduction category only. Tempo was only included in the models for the sudden categories. Despite the first order difference transformation and autoregressive adjustment, the effects of serial correlation were not completely removed for all of the models.

The emotional intensity ratings and the musical feature variables were graphed together for visual comparison and to help interpret the results of the regression study. The visualizations reveal distinct response profiles for each of the categories. Musicians and non-musicians exhibit similar emotional intensity curves for the gradual gestures (additive and reductive); however, musicians tend to anticipate the sudden changes. As a result, the musicians' emotional responses are heightened before the onset of the dramatic event

such as a sudden addition. The non-musicians trail behind changes in loudness and centroid.

For both gradual and sudden reductive excerpts, participants' responses display a sustained lingering effect of high emotional intensity despite the reduction of instrumental forces, loudness, and other parameters. We suggest that this anomaly is likely related to an "after-glow" effect (discussed by Schubert 1999), where emotional arousal continues even after the music has stopped. However, other parameters related to harmony and timbral or textural qualities may also play a role in the lingering intensity.

Conclusions

We suggest that time series regression analysis can be complemented by visualizations, which allow for both quantitative and qualitative comparison of excerpts within categories and across categories. The ability to quantify and view by instrumental family facilitates the analyses of timbral changes and their interaction with other musical elements. Additional musical feature overlays (such as phrase structure and harmony) could bring another important dimension to the analysis. In this way, traditional score-based analytical techniques are combined with and enhanced by acoustical information including spectral properties of the signal. In future work, we plan on coding other timbral predictors, such as spectral roughness and flux, as well as harmonic tension, attack density, and other formal characteristics, in order to better understand the interaction between orchestration and other musical parameters.

Overall, this exploratory study indicates the importance of researching orchestral gestures and the effect of timbral changes on the listening experience. We also propose that visualizations are a crucial analytical tool that can be used to illuminate results from other approaches.

Keywords

Orchestration, timbre, music and emotion

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