

**Towards a Theory and Analysis of Timbre  
based on Auditory Scene Analysis Principles:  
A Case Study of Beethoven's Piano Sonata Op. 106, Third Movement**

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## Introduction

The field of music theory and analysis has been traditionally and primarily focused on pitch organization systems, in particular through the development of tonal and post-tonal theories, including also duration aspects of music as is the case in theories of musical forms. However, theory and analysis based on the timbral dimension of music have become a developing area since the end of the 1970s. In studies like Erickson (1975), Cogan (1984), or Guigue (2009), specific attention is given to sound aspects of music, timbre no longer being considered as a secondary parameter (Nattiez, 2002), but rather as a multidimensional meta-parameter. In these studies, new analytical methods were developed, including in particular new approaches to musical scores as well as the use of visual representations in the form of graphs or spectrograms. Perceptual aspects – yet fundamental – are indeed discussed, but generally with few references to the psychological area. Only more recently has some research attempted to draw concrete propositions for the integration of psychological models such as the auditory scene analysis (Bregman, 1990) in the field of music theory and analysis, considering in particular orchestral repertoire (Touizrar & McAdams, 2019; Lalitte, 2019).

It is the aim of the present study to gain insight into the possibilities of application of auditory scene analysis principles for the study of timbre in a theoretical and analytical perspective, and to discuss their relevancy in the case of the third movement of Beethoven's Piano Sonata Op. 106. Composed in 1817–19 and titled “*Hammerklavier*”, this sonata is fully part of the last Beethoven style, known for its new conception of musical forms as well as its structural use of musical timbre (Boucouchre, 1991). Indeed, the third movement of Op. 106, organized as a wide sonata form in F sharp minor, is also characterized by its formal use of the *una corda/tre corde* sonority resulting in an overall *ABABA* multipartite timbre structure (Hérold, 2011, 414–17). This piece is therefore worth considering as a case study for a timbre analysis based on auditory scene analysis principles.

## Method

This research draws on the score of the Beethoven Adagio, as well as its audio recording (by pianist Alfred Brendel) – as written and sonic representations of the piece, respectively. After an intensive and detailed listening phase, the score is annotated in a systematic manner by means of colored frames, following the taxonomy and annotation system developed in the context of the Orchestration Analysis & Research Database (OrchARD, <http://orchard.actor-project.org>), as part of the ACTOR (Analysis, Creation and Teaching of Orchestration) partnership. Based on auditory scene analysis principles, this annotation system refers to the identification of different types of timbre and orchestration effects, as a result of concurrent, sequential and segmental auditory groupings (Goodchild & McAdams, 2018). As this method was originally developed for the analysis of symphonic music, its application to piano music requires some adjustments as regards the annotation tool itself as well as the underlying taxonomy.

## Results

Regarding the taxonomy and annotation system, the analysis of the Beethoven Adagio shows the possibility to describe a whole piano sonata movement in a systematic manner with analytical categories pertaining to auditory grouping principles. Originally designed for the analysis of orchestral music, their level of generality allows them to apply as well to other musical repertoires. Most of the categories are relevant in Beethoven's movement, which also accounts for the diversity of timbre and orchestration

situations that can be encountered within this piece. It is also interesting to note that these timbre and orchestration effects are not always independent from each other and that some of these can occur simultaneously, giving rise to superimposed analytical annotations on the score and, consequently, to different layers and levels of timbre and orchestration effects.

Furthermore, the analysis of the Beethoven Adagio sheds light on some aspects of the formal organization of the movement. With regards to the relation between the timbre and orchestration effects and the tonal-thematic dimension of the movement, it is worth noting that some effects have a greater weight in specific sections of the musical form. This is particularly obvious when considering the first thematic group in F sharp minor (mm. 1–26), which is mainly characterized by a perceptual fusion effect – including timbral augmentation but also timbral emergence effects, according to the taxonomy used – that predominates in duration in comparison with other secondary effects. In this passage of the movement, the fusion effect can thus be considered as a characteristic of a higher structural level – a kind of “dominant” timbre effect –, the other secondary effects having much more an ornamental function. The same kind of observation is relevant in the case of the transition section (mm. 27–44), based on stratification as a dominant effect, as well as the second thematic group in D major (mm. 45–68), provided with a coupling of stratification and timbral echoes effects.

Finally, the analysis of Beethoven’s Op. 106, third movement, questions, beyond auditory grouping effects as determinant of some aspects of timbre – but the latter being non-reducible to the former –, the general timbre dimension of the piece, which also involves piano specific features related to idiomatic writing configurations. This is particularly evident when considering effects pertaining to pedaling – including sustaining as well as *una corda* pedal aspects –, as well as effects related to a pianistic use of registers and doublings. These atypical situations are worth discussing with regard to the timbre and orchestration effects taxonomy that underlies the present Beethoven analysis.

## **Discussion**

This research leads to a better understanding of the Beethoven Adagio itself in terms of timbre organization, which is likely to converge with or diverge from the sonata form as a structural model. It brings some insight into the use of timbre and orchestration strategies in Beethoven’s late style and their role in order to renew the classical forms. Beyond this particular Beethoven case study, this research also brings to light concrete tools for the analysis of timbre in piano music and emphasizes the idea of orchestral piano (Hering, 1974) from an analytical perspective. Finally, this study contributes to the development of music theoretical aspects related to timbre and its structural conception, in particular through the idea of timbral effects on different hierarchical structural levels.

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## **References**

- Boucouchiev, A. (1991). *Essai sur Beethoven*. Arles: Actes Sud.
- Bregman, A. S. (1990). *Auditory Scene Analysis: The Perceptual Organization of Sound*. Cambridge (Mass.): The MIT Press.
- Cogan, R. (1984). *New Images of Musical Sound*. Cambridge (Mass.) : Publication Contact International.
- Erickson, R. (1975). *Sound Structure in Music*. Berkeley, Los Angeles, London: University of California Press.
- Goodchild, M., & McAdams, S. (2018). Perceptual Processes in Orchestration. In E. Dolan & A. Rehding (eds), *The Oxford Handbook of Timbre*. New York: Oxford University Press. <http://doi.org/10.1093/oxfordhb/9780190637224.013.10>

- Guigue, D. (2009). *Esthétique de la sonorité: l'héritage debussyste dans la musique pour piano du XX<sup>e</sup> siècle*. Paris: L'Harmattan.
- Hering, H. (1974). Orchestrale Klaviermusik. *Acta musicologica*, XLVI/1, 76–91.
- Héroid, N. (2011). *Timbre et forme : la dimension timbrique de la forme dans la musique pour piano de la première moitié du dix-neuvième siècle* (PhD thesis), University of Strasbourg, Strasbourg. [https://publication-theses.unistra.fr/public/theses\\_doctorat/2011/HEROLD\\_Nathalie\\_2011.pdf](https://publication-theses.unistra.fr/public/theses_doctorat/2011/HEROLD_Nathalie_2011.pdf)
- Lalitte, P. (2019). Vers une analyse texturale de la performance fondée sur les principes de l'analyse de scène auditive. In: P. Lalitte (ed), *Musique et cognition: perspectives pour l'analyse et la performance musicales* (pp. 231–252). Éditions Universitaires de Dijon, Dijon, France.
- Nattiez, J.-J. (2007). Le timbre est-il un paramètre secondaire ? *Les cahiers de la SQRM*, 9/1–2, 13–24.
- Touizar, M., & McAdams, S. (2019). Aspects perceptifs de l'orchestration dans *The Angel of Death* de Roger Reynolds: timbre et groupement auditif. In P. Lalitte (ed), *Musique et cognition: perspectives pour l'analyse et la performance musicales* (pp. 55–88). Éditions Universitaires de Dijon, Dijon, France.