Towards a Cognitive Musicology: an Inter-Individual Approach to the Perception of Beauty

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This project proposes to study the musical properties that determine the sensation of beauty in the listener when listening to a piece of music. It is based on a formal characterization of musical expectations. By proposing a formalization that models the *individual perception*, this project aims to overcome the difficulty posed by the notion of subjectivity, in order to identify the potentially universal structures of the perception of musical beauty. This theoretical work will be accompanied by an artistic creation directly resulting from the experimental results obtained.

Aesthetics is a field of knowledge that is as much interested in the conceptual characterization of the notion of beauty as in its phenomenological counterpart. Derived from the Greek *aisthesis* which means both *beauty* and *sensation*, the study of the beautiful can only be conducted at the intersection of a questioning that is both conceptual and concerned with perceptual phenomena. Is it a property of the mind, as suggested by Plato [1], or does it emerge from the inherent properties of the object, as postulated by Kant [2] ? Is it universally perceived or does it come from a subjective construction ? In other words, is it possible to identify, through an experimental psychological approach, the structural constituents of an object that determine the feeling of beauty ? And how can we get around the subjective bias inherent in this perceptual construction ?

Music seems to provide a very favourable framework for this study. Indeed, music, unlike the visual arts, has a degree of abstraction that allows us to represent abstract formal organizations such as grammatical structures. Recent studies have shown that statistical models [3] trained on a large number of scores can reliably describe the cerebral processing of melodic expectations. These have been used to show that the expectation break signal, assessing for each note its improbability, is represented in the auditory cortex when listening to music [4].

Furthermore, it has also been shown that musical pleasure as well as other emotions are based on this expectation signal [5] [6] [7]. Different structures of this signal would generate different emotions. However, this expectation signal seems to be highly subjective [8] and variable between individuals from different cultures [9] [10] [11]. This is why the characterization of the function between musical stimulus and perceived emotion cannot spare an estimation of the expectation model at the individual level.

The methodology we propose aims precisely at estimating this signal from behavioural data based on the *melodic priming* [12] [13]. This method will allow us to link the musical expectation breaking signal encoded in the brain of each participant *individually* with the evaluation of the intensity of the feeling of beauty by the same participants.

Thus, two mechanisms emerge : on the one hand, a subjective mechanism, determined on an individual scale by constructing a musical expectation model, and on the other hand, a function that generates, from the output of the expectation model, the feeling of musical beauty. This function could be subjective or shared by a large number of listeners. With regard to the literature on the subject, we make the hypothesis that this second mechanism is likely to be more shared between individuals than the first. Formalizing the parameters of this function will consist in establishing which cognitive mechanisms are at the origin of the feeling of beauty and to what extent they constitute an universal perceptive law.

We will evaluate these questions through several experiments in experimental psychology. First, we will define a method to estimate musical expectations directly from behavioural data. This will allow us to develop a predictive model of musical expectations at the individual level. It will also allow us to understand how individual musical culture shapes the construction of a model of musical expectations. Finally, participants will be asked to note the intensity of the sense of beauty for each musical excerpt in each experiment. From the individual expectation signal and the notation of the feeling of beauty, we will try to establish the function to generate the latter from the former. These data will thus make it possible to evaluate the universal character of this mechanism.

An artistic project will be carried out in parallel with the scientific work and will be based directly on the experimental results obtained. We will use the musical expectation models estimated for different individuals to generate different melodies but likely to generate a similar feeling of musical beauty in different participants. This will give listeners the opportunity to appreciate the articulation between a subjective musical expectation perception system and the universality of the resulting sense of beauty.

In conclusion, it should be noted that this project helps to overcome a conceptual difficulty inherent in the notion of beauty. By attempting to evaluate, for each individual, what provokes the feeling of beauty based on a model of musical expectation, this study returns to the original definition of aesthetics : describing beauty as *sensation*, individually determined and universally shared.

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