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Dynamic Grammar of Tonality: the Real-Time Understanding of Tonal Music

ABSTRACT

Background

In the field of tonal cognition studies, the Generative Theory of Tonal Music (Lerdahl and Jackendoff 1983) is the milestone from which a plenty of theoretical and empirical researches flourished in the last decades, aimed at deepening aspects of the theory.

A main issue regarding GTTM, particularly its prolongational theory deriving time-span and prolongational reductions, is widely recognized: the approach is static, a 'final state' approach, and the structural descriptions are given for the entire musical passage under analysis, without considering how such structures are inferred during the real–time process of music understanding. Indeed, the so–called preference rules for deriving well–formed prolongational reduction, in the GTTM, are hardly conceivable as a real–time parsing system.

Aims

The prolongational reduction (usually represented in the format of strictly hierarchical tree-graphs) gives an account for the tensing–relaxing patterns in tonal music, where more stable pc–events are locally governing the less stable ones, with the latter being a (recursive) prolongation of the former.

My purpose is to illustrate a temporal–dependent model of the inference of such prolongational trees. The model is based on the assumption that listeners predict the recovering of the tonal sense, i.e. the completion of the GTTM basic normative tree–structure. This starting disposition is the main goal of the comprehension process, gradually fulfilled as the listening to music goes on, by recursively generating sub–goals. Thus, a left–to–right parsing system is outlined, a system going on by alternating scanning, predictions, and revision steps. Partiality is allowed, to the extent that stored partial trees play the role of the structural context against with the current input is interpreted. The formal grammar apparatus adopted is "categorial", borrowed by the linguistic paradigm of categorial grammars (Morrill 2011). The objective (and, hopefully, the result) of the model, in which grammar and parsing are integrated, is mainly that of formalizing the role of expectation, as governing interpretation, in tonal cognition, and of exploring the interaction memory–perception–prediction, conceived as a procedural mechanism (assumingly, an algorithm) for the growth and revision of mental representations in real–time music processing.

Methods

The formal apparatus is slightly different from that of context–free grammar for tonal harmony introduced by Rohrmeier 2011, but essentially based on similar presuppositions. Apart from the minor difference due to the shift from the context–free to the categorial grammatical apparatus, the more relevant distinction is in the design of the tonal categorical architecture. In my model, the predominant area, in a chords progression tonally sensible, is a prolongation of the entire cadence, and not, as in Rohrmeier's model, a prolongation of the dominant chord. There is here an issue regarding the surface vs. deep phrase structure representation, relative to the position and the role of the predominant chords in the tonal template (see Katz and Pesetsky 2011). My model adopts the Katz and Pesetsky hypothesis of the movement of the dominant chord from its original, deep, position as head of its own phrase toward the position as prefix of the tonic inside the cadence. In other terms, the surface/deep structure distinction, in the representation of the syntactic structure of tonal harmony, disappears, although it could be maintained at pure interpretative, mental, level.

Regarding the dynamics, it is introduced, in a rule-based (deterministic) and symbolic fashion, by importing the theoretical linguistic 'dynamic turn' from natural language grammar (Kempson et al. 2001) to tonal music grammar. Indeed, the grammar is conceived as a top-down parsing system, guided by the initial goal of the full tonal template recovering, and going on through the alternation of scanning steps of the incoming chords progression, tree construction steps building up the syntactic representation according to the currently available materials, and tree revision steps triggered by failure in the integration of the new materials in the growing structural context.

Implications

The model implies a hierarchical conception of the syntactic organization of chords progressions in tonal music. Notoriously, the issue is rather puzzling. Hierarchical representations, in linguistic theories, account for recursive expansion of headed phrasal units (recursive 'External Merge', in the minimalist jargon – see Hornstein et al. 2005), and movements (or 'Internal Merge'), for dealing with long-distance dependency. Now, musical syntax, I argue, exhibits both the features, although with non-negligible idiosyncrasies. Particularly, recursive expansion is an essential feature of the functional characterization of tonal harmony, accounting for tensing-relaxing patterns and for differences in relative stability between chords (i.e., for the prolongational relations). Indeed, functional units, with their governing heads, can recursively be expanded.

Ultimately, although the issue of the (perceivable) hierarchical representation of tonal syntax is disputable, the alternative, a flat model of tonal syntax, presumptively conceived as a "Markov chain" where each chord affects at most the following one, is anyway problematic. One can argue for different way of listening: while a naïve listening involves only the feeling of the single chord passing into the following one, a

more trained listener can have some intuition of the hierarchical structures of a tonal progression.

Finally, as a theoretical model, the dynamic grammar of tonal music here proposed should be undergone to an experimental verification, in order to evaluate its psychological plausibility. It should be tested in the specific predictions it produces during the real–time listening process, while, as a model directed to formalize expectation, it can be supported by the wide existing psychological and neuroscientific literature on the topic (see Fitch et al. 2014). As a formal model, it should be implemented, in order to estimate its computational complexity.

Keywords

Music Cognition, Tonality, Formal Grammars, Dynamics.

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