Modelling shared constraints in language and music: poly-rhythm processing in Dynamic Syntax

It has recently been argued extensively that language and music share neural mechanisms as evidenced by the activation of overlapping brain regions during processing in each domain, interference effects, and parallel neurological deficits (e.g. Abrams et al., 2011; Sammler et al., 2009, 2011). Moreover, processing in both of these domains, language and music, seems to be subsumed by the mechanisms involved in action perception and execution. The common factor appears to be that all these domains involve time-linear sequential processing of stimuli (e.g. sentences, musical phrases, goal-directed actions) consisting of discrete elements (e.g. words, tones, motor acts) controlled by reference to hierarchically-organised structures (e.g. in language: meaning representations like tree-structures, LFs, DRSs etc; in music: hierarchies of pitches, meter etc.; in purposive action (see Butterfill & Apperly 2011): object-directed, goal-directed, and intentional action-levels). The mappings in these domains seem also to be characterised by rule-systems (e.g. language-specific syntactic constraints determining "grammaticality"; culture-specific tonal systems determining harmonic congruence; task-specific constraints determining ordering of (sub)sequences of movements). Reflecting these, during processing, these underlying rule-systems can be taken to generate top-down expectations (predictions) for upcoming events thus facilitating, e.g., semantic/pragmatic interpretation in language, consonance/dissonance judgements in music and behaviour understanding in action observation. Consequently, recent work in linguistics has argued for a shift in perspective from the familiar assumption that linguistic mechanisms are encapsulated and domain-specific to a radical alternative in which the "grammar" is formulated in terms of domain-general actions coordinating interaction between participants in real time (Dynamic Syntax (DS): Cann et al 2005, Gregoromichelaki et al 2011), Within this novel perspective, strong parallelisms between music and language processes emerge (Kempson and Orwin 2013), opening up the possibility of a much stronger correspondence between grammar and music processes (Gregoromichelaki 2013, Chatzikyriakidis 2013) than previously envisaged (Patel 2004). This paper argues that these correspondences can be extended even further, in the domain of rhythm processing, with experimental testing of this correspondence.

The core of the DS system are the concepts of prediction, underspecification, and update relative to context, all following the time-line of processing, with "syntax" defined as a set of actions licensing progressive interpretation/linearisation of signals. This process is underpinned structurally through the constraints of a tree-logic for representing contents. One such constraint is the license in principle of multiple processes of building any single tree-relation, yet the effective indistinguishability of any such multiple instantiations. This restriction affects most strikingly the building of nodes with an underspecified relation, as this constraint will have the effect of precluding there being more than one such structural relation of a type at a time. This constraint has been well-documented as an explanatory mechanism for linguistic phenomena, and, given the domain-generality of the DS vocabulary, this stance would predict the analogue of such a restriction in other cognitive domains like music.

This paper explores the issue of whether perception/production of poly-rhythms, the apparently simultaneous performance of multiple rhythmic bases (London 2012), is a test case against such a constraint applying in the music domain. Against this assumption we present an alternative characterisation of these data as either (a) a projection of sets of local rhythm dependencies, or (b) a routinisation over individual instances of such composite projection (Chatzikyriakidis 2013). We present a modelling of these options within DS so that specific predictions can be formulated in order to test these alternatives experimentally, as a further step of validating the applicability of specific DS mechanisms to music.

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