THE CULTURAL EVOLUTION OF STRUCTURE IN MUSIC AND LANGUAGE

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Introduction. Humans are well-versed at perceiving and learning sequences. If confronted with language or other culturally-transmitted systems in the lab, humans introduce and amplify structural regularities making the systems easier to learn (Kirby, Griffiths, & Smith, 2014; Verhoef, Kirby, & de Boer, 2014). In particular, *systematicity* frequently evolves in these experiments. Individual items are easier to reproduce by virtue of patterns of similarity across the entire *set* of items that are learned (Cornish, Smith & Kirby 2013). Is this process of system formation language-, task- or domain-specific (Iversen, Patel, Nicodemus, & Emmorey, 2015; Patel, 2007)? Can cultural transmission explain universals in musical structure as it explains linguistic universals (Jackendoff, 2009; Trehub, 2015)?

Methods. We tested 48 participants in a non-linguistic iterated learning task, featuring transmission of information across generations of learners. Participants were asked to imitate sets of drumming sequences as accurately as possible using an electronic drum kit. Following Cornish et al (2013), the task involved immediate imitation of each sequence in the set, rather than exposure to the full set of items prior to production. While the first generations of participants had to reproduce drumming patterns with random inter-beat intervals (i.e. time between

onsets of adjacent drum hits), later generations were asked to copy the imperfectly recalled patterns of the previous generation of participants.

Results. First, similarly to other experiments using language-like stimuli, systematic structure emerged over time. Over experimental generations and within transmission chains, drumming sequences became: (i) more rhythmic; (ii) easier to learn, shown by measuring imitation fidelity; (iii) more systematic: i.e the structure of each sequence in a recalled set provides expectations about the structure of other sequences. Second, the evolution of structure in this duration-based task strikingly resembled independent results in a visual sequencing task (Cornish et al., 2013), suggesting that either one domain-general or two analogous domain-specific mechanisms underpin similar pressures for systematic structure across domains. Third, our experimental transmission chains recreated rhythmic features which are statistical universals of world music (Savage, Brown, Sakai, & Currie, 2015). In fact, over generations, drumming sequences became: (i) more isochronous, (ii) composed of few (categorically distributed) alternating inter-beat intervals, related by small integer ratios, and (iii) more structured, containing repeating motivic patterns.

Conclusions. The emergence of systematic structure via cultural transmission: (a) does not require semantics or learning language-like behaviours; (b) operates similarly across domains and modalities of human cognition; (c) explains characteristics of musical rhythms appearing as statistical universals around the world (Savage et al., 2015; London, 2012). Future research should replicate this experiment in participants of different age groups, cultures and literacy in order to disentangle group-specific from human-universal cognitive biases (Ravignani, 2015; Trehub, 2015).

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