CHIMPANZEES PROCESS STRUCTURAL ISOMORPHISMS ACROSS SENSORY MODALITIES

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Humans and other animals are constantly exposed to environmental stimuli, from which they extract sensory regularities (Fitch, 2014; ten Cate and Okanoya, 2012). Moreover, they often relate and integrate one-dimensional quantities across sensory modalities (Ludwig et al., 2011), for instance relating conspecific faces to voices (Seyfarth and Cheney, 2009). If basic patterns like repetitions and identities are perceived in different sensory modalities (Ravignani et al., 2013; Ravignani et al., 2015; Sonnweber et al., 2014), it could be advantageous to detect cross-modal isomorphisms, i.e. modality-independent representations of structural features, which could be used in visual, tactile, and auditory processing. Humans can transfer structural regularities learnt in one modality, e.g. visual sequences, to another modality, e.g. unfamiliar sound sequences (Altmann et al., 1995). To date, this ability to map structural regularities across domains has not been demonstrated in other animals. Here we show that two chimpanzees trained to choose symmetric sequences of geometric shapes spontaneously detected a visual-auditory isomorphism. Although chimpanzees were never trained to associate sounds to images, their response latencies in choosing symmetric visual sequences was shorter when presented

with (structurally isomorphic) symmetric, rather than foil sound triplets. Thus, previously unheard sound sequences influenced the choice of visual sequences solely based on structural similarities. This provides the first evidence of structure learning across modalities in a non-human animal. Our findings suggest that human language is not a prerequisite to map abstract structures between modalities. Cross-modal abilities might instead have constituted a precursor to human linguistic abilities (Cuskley and Kirby, 2013), involving evolutionary old neural mechanisms (Ghazanfar and Takahashi, 2014).

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