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The role of timbre, envelope and movement on audio-visual integration of musicians movements

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Specific acoustic properties meaningfully shape the perceptual system's binding of sight and sound (Vatakis & Spence, 2007, 2008). One understudied acoustic property in cross-modal integration is amplitude envelope, the way in which a sounds loudness changes over time. Here we examine the effect of amplitude envelope (flat versus percussive) on binding. Participants completed a temporal order judgement (TOJ) task, indicating which sensory modality was presented first. We hypothesized better binding for percussive envelope natural sounds compared to flat pure tones. Our preliminary results show a larger binding window for natural percussive tones. Further research into the role of timbre, temporal variation, and movement in cross-modal integration will help further our understanding on binding of natural stimuli.

KEYWORDS: *cross-modal integration, unity assumption, amplitude envelope, timbre*

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The effect of timbral and non-timbral cues on the rapid recognition of songs from single opening chords

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It is currently believed that timbre plays a primary role in the identification of songs from very brief excerpts of music (McAdams & Siedenburg, 2019; Wallmark, Iacoboni, Deblieck, & Kendall, 2018). However, the specific contribution of timbre and other parameters to that type of identification remains unclear. By investigating the identification of songs from single piano and piano-driven block chords, the present study focuses on the role of timbre, vertical pitch structures, and duration in the rapid recognition of songs. Ninety-three participants were asked to identify 20 well-known songs from their opening piano or piano-driven block

chord. We evaluated the contribution of 10 chord characteristics to song identification. Chord characteristics related to timbral brightness, pitch register, and duration were chosen due to their high perceptual salience according to a chord similarity estimation test that the participants completed after the main task. The other variables were selected based on theoretical predictions regarding auditory long-term memory. While participants' musical background did not affect their ability to identify the songs, the chords' timbral brightness and, to a lesser extent, their attack time, chord-type commonness, duration, and the songs' year of release contributed to the songs' recognition rate. This study shows that participants with and without musical training are able to identify songs from a single piano chord and suggests that both timbral and non-timbral cues contribute to this remarkable ability.

Partial-oriented listening and the timbre-pitch perceptual continuum

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Partial-oriented listening is a mode of listening that entails attending to timbral upper partials as potential pitches, hearing out spectral prominences distinctly from timbral aggregates. Questions such as "What is the highest pitch you hear?" and "How many pitches do you hear?" invite partial-oriented listening, which can be considered a "top-down"—that is, attend to high frequencies first and then to low frequencies—top-down listening strategy. I posit the existence of a timbre-pitch continuum of percepts of upper partials arising from the confluence of top-down listening strategies (such as partial-oriented listening) and bottom-up acoustic features (such as spectral fission, my theorization of the other side of the coin to McAdams's "spectral fusion" that describes situations in which many listeners are likely to perceive a timbral upper partial as a discrete pitch). I argue that in order to best account for both flexibility of listening behaviors for any given listener as well as individual differences between listeners, it is most productive to center variance and variety along this continuum in terms of modes of listening and listening behaviors rather than "types of listeners." In other words, any individual listener is better represented by a band of percepts along the continuum than by any one individual percept on it. I present this theoretical framework to facilitate study of the role of individual differences in timbre and pitch perception and to embrace the diversity of potential perceptual experiences that can arise from different modes of listening to the same sound.

KEYWORDS: *pitch perception, partial-oriented listening, timbre-pitch continuum, spectral fission, auditory attention, individual difference, timbre*

Towards a theory of instrument-specific absolute pitch: Effects of timbre and motor imagery

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While absolute pitch (AP)—the ability to name musical pitches without reference—is rare in expert musicians (Levitin & Rogers, 2005; Ward, 1999), anecdotal evidence suggests that some musicians may better identify pitches played on their primary instrument than pitches played on other instruments. We call this phenomenon "instrument-specific absolute pitch" (ISAP) and offer the first theory of underlying mechanisms (Reymore & Hansen, 2020). This theory is situated in neuroscientific research on the multimodal nature of expertise (e.g., Krishnan et al., 2018; Proverbio & Orlandi, 2016). We propose that informative timbral cues arise from performer- or instrument-specific idiosyncrasies or from timbre-facilitated tonotopic representations and that sounds of one's primary instrument may activate kinaesthetic memory and motor imagery, aiding pitch identification (Hansen & Reymore, 2021). Hypotheses derived from this theory are tested in two professional oboists. Only one of the two oboists showed an advantage for identifying oboe tones over piano tones. For this oboist, pitch-naming accuracy decreased and variance around the correct pitch value increased as an effect of transposition and motor interference, but not of instrument or performer. These results suggest that some musicians possess instrument-specific absolute pitch while others do not and that candidate mechanisms behind this ability capitalize on timbral cues and motor imagery. In a Registered Report (Hansen & Reymore, 2021), we plan to extend these findings to a larger population of oboists. A deeper understanding of instrument-specific absolute pitch has theoretical implications for research on musical expertise, absolute pitch, timbre and pitch cognition, and musical embodiment, as well as practical implications for musical practice and pedagogy. Finally, the theory offers several directions for future research, employing behavioral, neuroimaging, and brain stimulation methods.

KEYWORDS: *absolute pitch, timbre, motor planning, pitch perception, oboe*

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