The apparent simplicity of tapping to a beat is deceiving. In fact, this task is a complex ability, rare across species, which relies on an intricate network of motor and sensory subcortical and cortical brain areas. This complexity makes the task of disentangling the neural foundations of synchronization ability daunting, especially as there is little previous work on which to draw. In Tierney and Kraus (2013) we discovered that trial-by-trial temporal variability of auditory processing in the midbrain tracks with the variability produced by subjects when tapping to a beat. Given the existence of direct connections between the auditory midbrain and the cerebellum, and the importance of the cerebellum for synchronization tasks, we interpret this finding as indicating that the fine time perception necessary for determining the temporal relationship between tap and sound relies on temporal precision of auditory processing.

This interpretation, however, does not downplay the role of memory, attention, and other so-called "top-down" processes. On the contrary, temporal variability of auditory processing is almost certainly driven by a number of factors, including modulatory influence from cortical areas via corticofugal connections. Rather than specifying "bottom-up" versus "top-down" processes, a more inclusive view is to view the system as an interactive feedback loop of afferent and efferent influences. The influence of cognitive factors on subcortical auditory function, including trial-by-trial neural consistency, is an exciting area of research. What is known is that experience can modulate subcortical response consistency (Hornickel et al. 2012), likely through the corticofugal system (Gao and Suga 2000). Thus a participant's response to sound reflects the influence of their entire auditory system over a lifetime of accumulated experience (Kraus and Chandrasekaran 2010). That is, our neural metric reflects cognitive, sensory and reward circuitry of which the midbrain is a part and the auditory experiences of the subject throughout life. This approach provides groundwork for further informing our understanding of individual differences in synchronization skill.

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