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Selective preservation of the beat in apperceptive music agnosia: A case study

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ABSTRACT

Introduction: Music perception involves processing of melodic, temporal and emotional dimensions that have been found to dissociate in healthy individuals and after brain injury. Two components of the temporal dimension have been distinguished, namely rhythm and metre. We describe an 18 year old male musician 'JM' who showed apperceptive music agnosia with selectively preserved metre perception, and impaired recognition of sad and peaceful music relative to age and music experience matched controls after resection of a right temporoparietal tumour.

Method: Two months post-surgery JM underwent a comprehensive neuropsychological evaluation including assessment of his music perception abilities using the *Montreal Battery for Evaluation of Amusia* (MBEA, Peretz, Champod, & Hyde, 2003). He also completed several experimental tasks to explore his ability to recognise famous songs and melodies, emotions portrayed by music and a broader range of environmental sounds. Five age-, gender-, education- and musical experienced-matched controls were administered the same experimental tasks.

Results: JM showed selective preservation of metre perception, with impaired performances compared to controls and scoring below the 5% cut-off on all MBEA subtests, except for the metric condition. He could identify his favourite songs and environmental sounds. He showed impaired recognition of sad and peaceful emotions portrayed in music relative to controls but intact ability to identify happy and scary music.

Conclusion: This case study contributes to the scarce literature documenting a dissociation between rhythmic and metric processing, and the rare observation of selectively preserved metric interpretation in the context of apperceptive music agnosia. It supports the notion that the anterior portion of the superior temporal gyrus (STG) plays a role in metric processing and provides the novel observation that selectively preserved metre is sufficient to identify happy and scary, but not sad or peaceful emotions portrayed in music.

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1. Introduction

Perception of music involves processing multiple components. Peretz et al. (2003) have outlined a music processing model with two main dimensions, melodic (defined by sequential variations in pitch) and temporal (defined by sequential variations in duration). The melodic dimension comprises subcomponents of pitch interval (distance between pitches), contour (rise/fall of pitch) and scale (mapping of pitch onto keys). The temporal dimension comprises subcomponents of *rhythm* (the tendency to group events according to temporal proximity without regard for periodicity) and *metre* (based on the extraction of an underlying temporal regularity or beat). Music agnosia, or the inability to recognise familiar music, can arise from damage to one or more of these processing components. Music agnosia arising from a perceptual basis is termed ‘apperceptive music agnosia’ and can be congenital or acquired after brain injury (Ayotte, Peretz, Rousseau, Bard, & Bojanowski, 2000; Peretz, Brattico, Jarvenpaa, & Tervaniemi, 2009). Peretz et al. (2003) developed the *Montreal Battery for Evaluation of Amusia* (MBEA) as an assessment tool to examine music processing deficits that is widely regarded as the ‘gold standard’ for characterising amusia.

Previous neuropsychological research in patients with brain damage has documented a double dissociation between the ability to process two main components of music, namely rhythm and melody. Furthermore, the subcomponents can dissociate (e.g., metre/rhythm). Peretz and colleagues have conducted the majority of research in this area based on case or small group studies, with a focus on patients with temporal lesions. For example, Liégeois-Chauvel, Peretz, Babaï, Laguitton, and Chauvel (1998) found that the superior temporal gyrus (STG) is critical for melodic processing. In particular, right temporal resection resulted in impaired contour and interval processing, while left temporal resection only affected interval but not contour information. These authors also observed rhythm and metre dissociation and identified the anterior STG as critical for metric processing, with no laterality effect. The current case contributes to the scarce literature documenting such a dissociation and supports the critical role of the anterior STG in metric processing.

An integral component of music perception is its ability to elicit emotion. Notably, individuals with music agnosia remain able to identify specific emotions portrayed by music, suggesting that recognition and appreciation of emotional tone are processed separately (Peretz & Gagnon, 1999; Peretz, Gagnon, & Bouchard, 1998). Peretz and Gagnon (1999) described patient ‘IR’ with severe music agnosia subsequent to bilateral middle cerebral artery repair who could not recognise familiar music, but could still classify familiar or unfamiliar melodies as happy or sad. Interestingly, in the context of severely impaired MBEA performances, IR’s performance on the metric task was relatively spared (but still abnormal). The authors stated that “it is difficult to conceive how metric information is relevant to emotional evaluation” (p. 28) and argued that metric interpretation is built “on line” and, compared with the other MBEA tasks, is less demanding on short-term memory, which was impaired in IR.

Neuropsychological studies have investigated the neural correlates of emotional processing of music, with the majority examining patients with temporal lesions. For example, Gosselin et al. (2005) found that left or right temporal resection (including the amygdala) resulted in impaired recognition of scary music, spared recognition of happy music, and sad and peaceful music less clearly affected. In contrast, Khalifa et al. (2008) found a laterality effect after temporal resection as patients with right-sided resections were poor at recognising sad music (identifying it as ‘angry’), with recognition of happy music spared. In contrast, patients with left-sided resections were poor at recognising ‘happy’ music (identifying it as sad or angry), although ‘peaceful’ was not included in contrast to Gosselin et al. (2005).

We describe a patient with apperceptive music agnosia characterised by selective preservation of metric processing after a focal right posterior temporal lesion. The aim was to explore our patient’s ability to process the different components of music (as outlined by Peretz’s model). To date there is only a few published cases of selective preservation of metric processing in the context of a pervasive apperceptive amusia. Furthermore, our case provided the unique opportunity to further explore the relationship between selectively preserved metric processing and the ability to classify musical emotions. To the best of our knowledge, this is only the second study (in

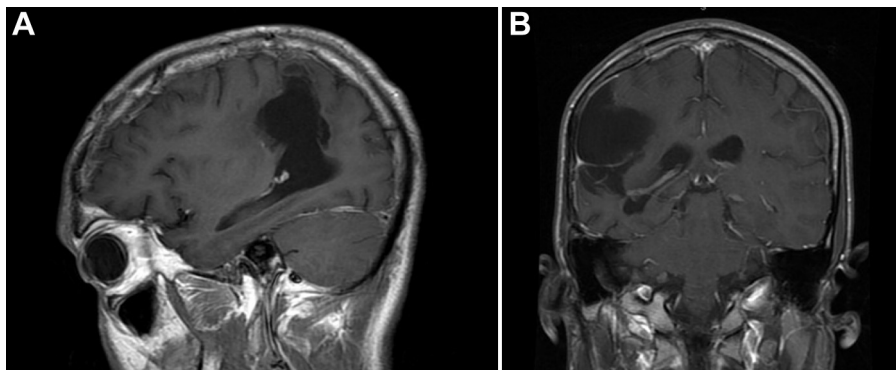


Fig. 1 – JM’s post-resection T1 MRI brain image in the sagittal (A) and Coronal (B) plane showing focal damage to the posterior third of the superior temporal gyrus encroaching on the posterior third of the middle temporal gyrus. The inferior parietal region, encompassing the supramarginal and angular gyri was also affected.

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