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# Recognition of leitmotives in Richard Wagner's music: chroma distance and listener expertise

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**Abstract.** The leitmotives in Richard Wagner's *Der Ring des Nibelungen* serve a range of compositional and psychological functions, including the introduction of musical structure and mnemonic devices for the listener. Leitmotives in the Ring differ greatly in their construction, salient aspects (e.g. rhythmic, melodic, harmonic), and their usage in particular scenes and contexts.

We aim to understand listeners' real-time processing of leitmotives, and have gathered data from a memory test, probing participants' memory for different leitmotives contained in a 10-minute excerpt from the opera *Siegfried*. An item response theory (IRT) approach was used to estimate item difficulty parameters as well as parameters characterizing participants' individual recognition ability. We fit a series of IRT models to the data obtained from 68 participants, finding that a Rasch Model with an unconstrained but fixed discrimination parameter fit the data best according to the Bayesian Information Criterion. We further investigated the relationship between model parameters and factors such as: number of leitmotive occurrences in the excerpt; acoustical distance using chroma features (Mauch & Dixon, 2010) and distance thresholding (Casey, Rhodes & Slaney, 2008); extent of musical training; and objective and self-reported Wagner expertise, finding that performance in the objective Wagner test and chroma distance were statistically significant predictors, while number of occurrences, self-reported Wagner expertise and extent of musical training did not reach significance.

## References

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## Keywords

MUSIC, MEMORY, ITEM RESPONSE THEORY, LEITMOTIVES