Enhanced feature integration in musicians: Expertise modulates the additivity of the MMNm response

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BACKGROUND

- Feature integration happens from birth[11] and is crucial to survival[2].
- Its developmental and training-related trajectories have been revealed for vision[9], but are unknown/understudied for audition[4].
- Music combines features (e.g., pitch, location, intensity, timbre) whose conjunctions establish ambiguous syntax & emotion[6-7].
- Musical practice causes structural and functional brain changes[8] → Does musical expertise lead to more overlap in neural processing of auditory features? Are such effects context-dependent?

METHODS

- MMNm additivity (top right) with magnetoencephalography (MEG).
- 25 musicians + 25 non-musicians.
- 7 deviant types: P, I, L, PI, IL, LP, PIL (see below).
- Data analysis: Cluster-based permutation tests[11], 100-300 ms post-stimulus for 2 x 9 peak gradiometer pairs.

RESULTS & CONCLUSION

- MMNm is present in both groups for all deviants in both paradigms.
- MMNm is additive: Generally, triple > double > single deviants.
- However, greater MMNm underadditivity in musicians: Expertise-by-additivity interaction, only in musical paradigm for PI, LP, & PIL.
- In musical contexts only, musicians show greater overlap than non-musicians in neural processing of pitch with other features.

How? Subtract sum of single-deviant MMNms (modelled) from double/triple-deviant MMNm (empirical), e.g., P = pitch, I = intensity, PI = double deviant.

Why? Quantifies neural processing overlap[12].

MMNm additivity

empirical PI - (modelled PI) = PI additivity

M1 - M4: Musical multi-feature paradigm

C1 - C3: Control paradigm

PI

IL

LP

PIL

11 deviants

12 pitch levels

11 iterations

4 blocks

MMNm

\[ \text{MMNm additivity} = \text{empirical PI} - \text{modelled PI} \]

\[ \text{M1} - \text{M4: Musical multi-feature paradigm} \]

\[ \text{C1} - \text{C3: Control paradigm} \]

\[ \begin{aligned}
\text{M1} & \quad \text{M2} & \quad \text{M3} & \quad \text{M4}
\end{aligned} \]

\[ \begin{aligned}
\text{C1} & \quad \text{C2} & \quad \text{C3}
\end{aligned} \]

\[ \begin{aligned}
\text{Pitch (1-3 cents)} & \quad \text{Intensity (1-12 dB)} & \quad \text{Location (delayed 200µs)} & \quad \text{Pitch & Intensity} & \quad \text{Intensity & Location} & \quad \text{Location & Pitch} & \quad \text{Pitch & Intensity & Location}
\end{aligned} \]


MIB - The Royal Academy of Music Aarhus/Aalborg

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