

Protective effects of combined audiovisual stimulation on temporal expectations in noisy environments

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Background

In real life, we are exposed to a rich environment, a complex and continuous stream of multisensory information. This information needs to be integrated to generate a reliable mental model of our world. There is converging evidence that there are at least two optimization mechanisms to integrate incoming information: multisensory interplay (MSI) and temporal expectations (TE). However, how these mechanisms interact is currently unknown.

Multisensory Interplay (MSI)^{1,2,3,4}

Unisensory



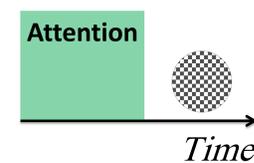
Multisensory



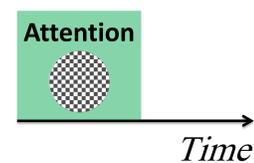
Irrelevant or redundant
additional stimulus

Temporal Expectations (TE)⁵

Unattended



Attended



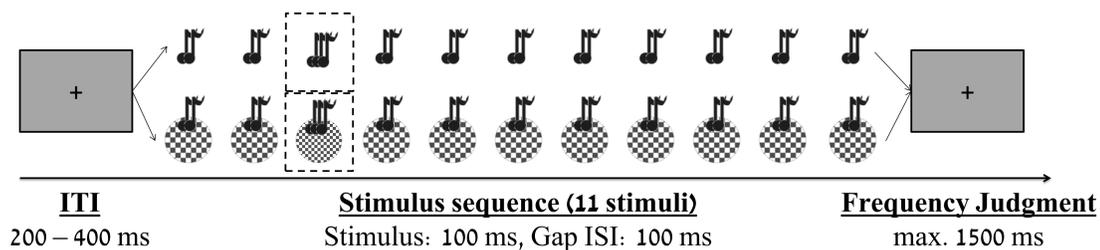
Performance (e.g. d-prime)

Unisensory < Multisensory

Unattended < Attended

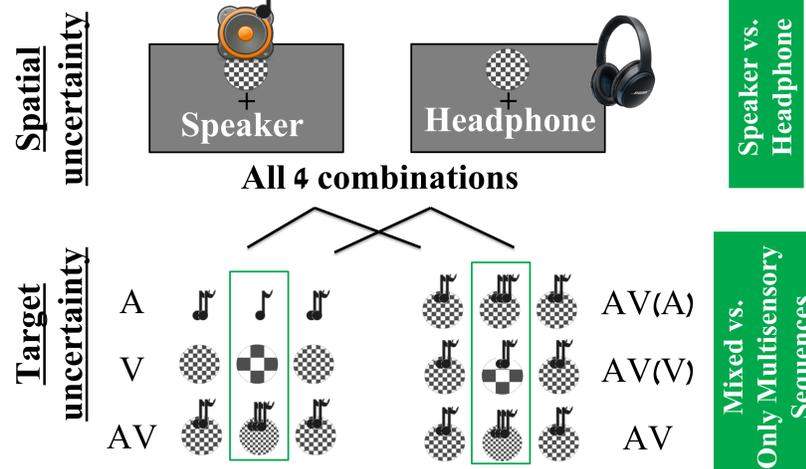
Methods

2 Examples for one trial: unisensory and multisensory sequence



- MSI and TE might depend on difficulty/level of noise
 - Sequences were either mixed (A, V, AV) or just multisensory
 - Sounds were presented with speaker or headphone
- We used d-prime as performance measure

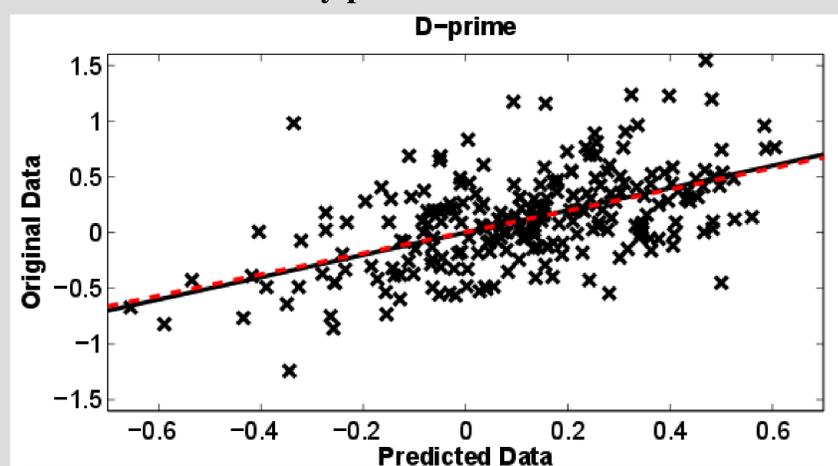
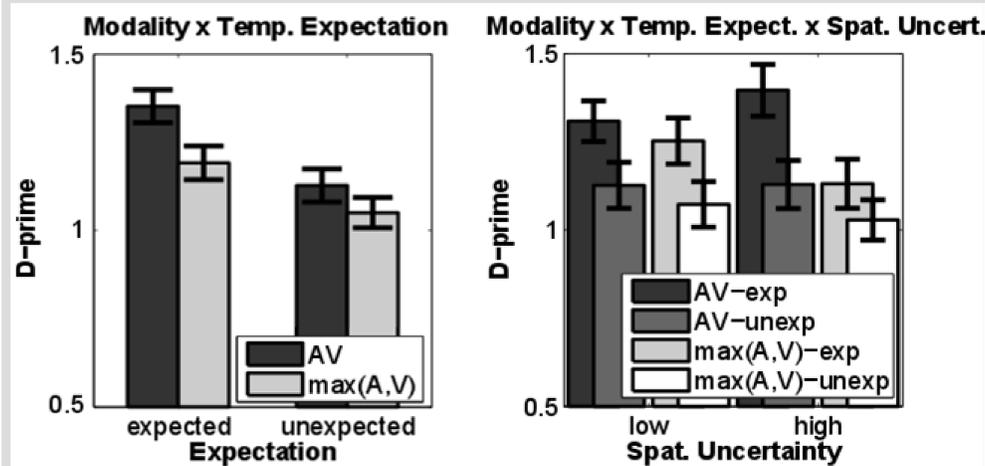
Low uncertainty High uncertainty



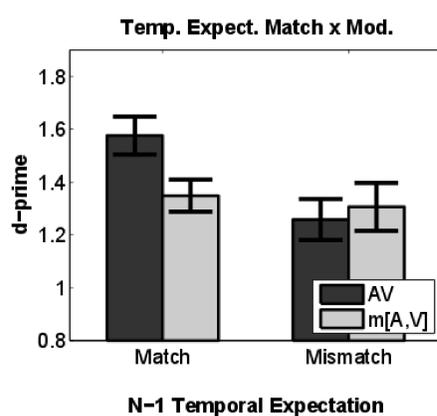
Multisensory performance enhancement interacts with performance enhancement by temporal expectation; especially under high spatial uncertainty.

MSI enhancement is best predicted by spatial and target uncertainty, TE, and more importantly, changes with performance in unisensory conditions (difference of minimal and maximal unisensory performance).

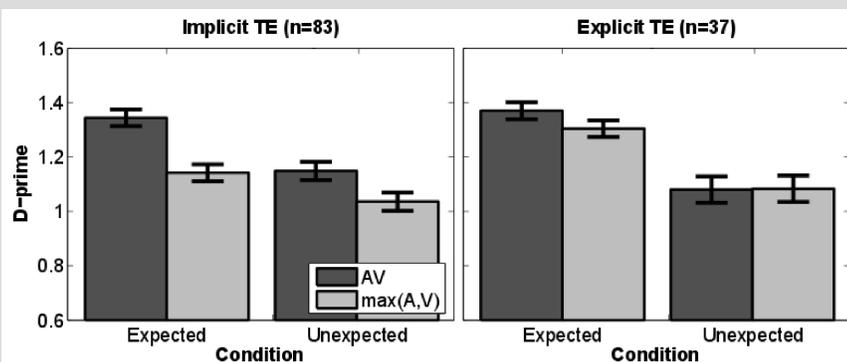
Results



Benefit of multisensory interplay for extraction of temporal regularities (to build up temporal expectations) is already present on a trial by trial level. Whenever successive trials match in their expectation level performance increases for multisensory stimuli.



Interaction of TE and MSI does not depend on explicit knowledge of temporal regularities ($F(1,118) = .54, p = .816$).



Most Relevant Results

- TE effects are enhanced for multisensory relative to unisensory stimulation, especially under e.g. high spatial uncertainty
- MSI interacts with TE trial-by-trial
- Effects are independent of explicit temporal knowledge

Conclusion

Together, the pattern of results indicates that multisensory stimulation has a protective and enhancing effect on the generation and usage of temporal expectations, highlighting the need for multisensory paradigms in future studies investigating temporal expectations.

References

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Summary