Temporal entrainment from a perceptual and neural standpoint

Anne Kösem1,2, Virginie van Wassenhove1,2

1 INSERM, U992, Cognitive Neuroimaging Unit, F-91191 Gif-sur-Yvette, France
2 CEA, DSV/I2BM, NeuroSpin Center, F-91191 Gif-sur-Yvette, France
3 Univ Paris-Sud, Cognitive Neuroimaging Unit, F-91191 Gif-sur-Yvette, France

INTRODUCTION

Neural entrainment

- Brain rhythms can phase-lock to the temporal structure of sensory events
- This phenomenon has been suggested to underlie attentional selection of sensory streams in time [1,2]

In multisensory context

- Delta (1-2Hz) oscillations in visual cortex entrain to the rhythm of stimulation of the attended sensory modality (auditory or visual) [2]
- Audiospatial (AV) neural phase-reset and entrainment are suggested to modulate visual detection performances [3]. But these effects seem to be temporally bounded.

Can automatic AV integration be explained by a low-frequency neural entrainment mechanism?

Visual search paradigm with auditory cue (adapted from [4])

- target: vertical or horizontal line
- lines change color through time at a certain temporal rate
- AV: sound synchronized with target color changes
- AV: sound synchronized with a distracter color changes
- V: no sound
- temporal rate: 0.6, 0.8, 1.1, 1.4, 2, 3.3 and 10 Hz
- set size: 32, 48, 60 lines
- psychophysical measures: response times (RTs) and detection rate

Hypothesis

- Better and faster detection in AVc than in V and in AV
- Temporal ceiling effect

RESULTS

- Participants are faster in AVc than in V and AV across all temporal rates
- Participants are slower in AV than in V and AVc

CONCLUSION

- AV benefits in visual search present for temporal frequencies under 1.4 Hz
- AV neural entrainment would be specific to oscillations in the 1Hz range.

METHODS

IN PROGRESS

- Consistent with the hypothesis that AV binding relies on the entrainment of slow cortical oscillations (delta range 1-1.4Hz), our psychophysical experiment shows that AV integration is automatic with a temporal resolution of about 700 ms.
- This suggests that AV integration is tolerant for large asynchronies. Yet, AV information can be perceptually segregated on a much finer time scale (50-100 ms) when participants perform simultaneity or temporal order judgment tasks [5].

How can we reconcile these observations?

Paradigm: temporal recalibration [5]

- Adaptation period: Rhythmic stimulation with constant delay between sound and flash

Acknowledgements

This work was supported by a Marie-Curie IRG-246022 and an ERCITG - 263164 - MindTime - to VvW and by a Fondation GDF fellowship to AK.

We would like to thank Christophe Pallier for his precious help on statistical analysis.

References