Symposium | Space-Time Interference

Sat. Oct 18, 2025 10:45 AM - 12:15 PM JST | Sat. Oct 18, 2025 1:45 AM - 3:15 AM UTC Venue 3(KOMCEE W Lecture Hall)

[S5] Symposium 5: Space-time interference in behavior and neuronal processing

Chair:Martin Riemer(Technical University Berlin)

Time perception is related to the perception of space. This idea has received support from behavioral and neuroscience studies. At the behavioral level, mutual interference between the perception of time and space have been demonstrated. Larger objects are perceived as lasting longer, and the physical duration of stimuli affect their perceived size. Casasanto and Boroditsky (2008) reported evidence for an asymmetric relationship between space and time, with time being more affected by space than vice versa. This finding has stimulated the idea of a hierarchical representation of space and time, which is in line with conceptual metaphor theory but has also invoked skepticism (Riemer & Cai, 2024). The theory of an asymmetric representation of time and space is one focus of this symposium.
At the neuronal level, evidence for a common processing of time, space and other magnitudes in the parietal cortex (especially the right intraparietal sulcus; Bueti & Walsh, 2009) has led to the idea of a dimension-unspecific magnitude system. The idea of a common mechanism for the processing of temporal and spatial information has been reinforced by the discovery of time cells in the medial temporal lobe, a brain structure primarily known for its role in spatial processing (Eichenbaum, 2017). Together, these findings represent potential neuronal origins for the emergence of space-time interference in behavior.
The first two talks of the symposium are predominantly focused on behavioral studies about the (a)symmetric representation of time and space, while in the last two talks we will take a look at the neuronal processes underlying time and space perception.

10:45 AM - 11:00 AM JST | 1:45 AM - 2:00 AM UTC

[S5-01]

Space-time interference in behavior and neuronal processing

*Martin Riemer[1] (1. Technical University Berlin (Germany))

11:00 AM - 11:15 AM JST | 2:00 AM - 2:15 AM UTC

[S5-02]

Cross-dimensional interference between illusory size and duration

*Daniel Bratzke[1], Rolf Ulrich[2] (1. University of Bremen (Germany), 2.University of Tübingen, Germany)

11:15 AM - 11:30 AM JST | 2:15 AM - 2:30 AM UTC

[S5-03]

Using speed to think about space and time

*Martin Riemer[1] (1. Technical University Berlin (Germany))

11:30 AM - 11:45 AM JST | 2:30 AM - 2:45 AM UTC

[S5-04]

The neural link between stimulus duration and spatial location in the human visual hierarchy

*Gianfranco Fortunato[1], Valeria Centanino[1], Domenica Bueti[1] (1. International School for Advanced Studies (SISSA) (Italy))

11:45 AM - 12:00 PM JST | 2:45 AM - 3:00 AM UTC

[S5-05]

A different angle on space-time interference: Disentangling cognitive maps and graphs in the human brain

*Yangwen Xu[1], Max A.B. Hinrichs[1], Roberto Bottini[2], Christian F Doeller[1,3] (1. Max Planck Institute for Human Cognitive and Brain Sciences (Germany), 2. Center for Mind/Brain Sciences, University of Trento (Italy), 3. Kavli Institute for Systems Neuroscience (Norway))

Space-time interference in behavior and neuronal processing

*Martin Riemer[1]

1. Technical University Berlin

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Keywords: Space-time interference, spatial, speed, fMRI, time cells

Cross-dimensional interference between illusory size and duration

*Daniel Bratzke[1]

1. University of Bremen

Ono and Kawahara (2007) were the first to demonstrate that illusory size differences, as induced by the Ebbinghaus illusion, can interfere with the perception of duration and vice versa. This talk will present two studies, illustrating that this type of space-time interference (a) generalizes across various visual spatial illusions, including the Müller-Lyer, Ponzo, and horizontal-vertical illusions, (b) can be observed with different timing methods (categorization and temporal reproduction), (c) resembles space-time interference between physical size and duration, and (d) likely occurs fairly late in the processing stream.

References

Ono, F., & Kawahara, J.-I. (2007). The subjective size of visual stimuli affects the perceived duration of their presentation. Perception & Psychophysics, 69(6), 952–957. https://doi.org/10.3758/bf03193932

Keywords: size and duration

Using speed to think about space and time

*Martin Riemer[1]

1. Technical University Berlin

The observation of asymmetric interference between time and space, with time being more influenced by space than vice versa, has often been interpreted as reflecting a hierarchical representational structure. In this talk I will describe how the factor of speed, which is inherent in many experiments on space-time interference (e.g., growing lines, moving dots), can contribute to the observed asymmetry. I will present theroretical and empirical evidence that the introduction of speed leads to a more pronounced effect of space-on-time, and hence larger asymmetry. I conclude that the speed account provides a straightforward explanation for the phenomenon of asymmetric space-time interference in experiments using dynamic stimuli.

Keywords: space-time interference

The neural link between stimulus duration and spatial location in the human visual hierarchy

*Gianfranco Fortunato[1], Valeria Centanino[1], Domenica Bueti[1]

1. International School for Advanced Studies (SISSA)

A critical aspect of perception is the brain’ s ability to integrate multiple sensory dimensions. While spatial influences on duration perception have been documented, the neural link between spatial and temporal coding remains underexplored. Using ultra-high-field fMRI and neuronal-based modelling, we investigated where and how the processing and representation of visual duration and spatial location are related. We found that duration coding transforms along the cortical hierarchy—from monotonic and spatially dependent in early visual cortex to unimodal and spatially invariant in frontal areas.
Notably, in the dorsal visual stream, especially the intraparietal sulcus (IPS), neuronal populations show common selective responses for both spatial and temporal stimulus dimensions. Furthermore, spatial and temporal topographies are systematically linked in IPS. These findings provide insights into the neural mechanisms underlying visual duration perception and emphasize the importance of interactions between multiple sensory dimensions—space, time, numerosity, speed, etc.—in shaping brain responses.

Keywords: cortical hierarchy

A different angle on space-time interference: Disentangling cognitive maps and graphs in the human brain

*Yangwen Xu[1], Max A.B. Hinrichs[1], Roberto Bottini[2], Christian F Doeller[1,3]

1. Max Planck Institute for Human Cognitive and Brain Sciences, 2. Center for Mind/Brain Sciences, University of Trento, 3. Kavli Institute for Systems Neuroscience

Our mental representations can be structured into two basic formats. One is cognitive maps, where representational contents are arranged in a space and encoded as coordinates. The other is cognitive graphs, where representational contents are associated through co-occurrence in time and encoded among relations. However, these two forms of representations are usually correlated and confounded, making their neural underpinnings challenging to verify. For example, the "place cells" found in the hippocampus, which fire at particular locations in an environment, can also be interpreted as "time cells", which fire following a particular temporal sequence. In this symposium, I will present our recent fMRI study aiming to illuminate this puzzle. We let participants learn a virtual environment of an Euclidean graph where map and graph information is orthogonalized, and the neural underpinnings of these two forms of mental representations were unraveled using both univariate and multivariate fMRI methods.

Keywords: space-time interference