EEG reveals how space acts as a late heuristic of timekeeping

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Humans rely on spatial metaphors, gestures, and visual tools to represent the passage of time. Nonetheless, it is unclear to what extent space is an inherent component of the brain’s representation of time. Here, we combined EEG-behavioural measures in human participants and neural network models of optimal decision-making to show that space is a late compensatory mechanism of time representation recruited when faster non-spatial timekeeping mechanisms are sub-optimally engaged. We leveraged on the STEARC effect, which shows faster recognition of “short” time intervals with responses in the left side of space and faster recognition of “long” intervals with responses in the right side, and on the recent finding that the STEARC is absent when RTs/decisions are fast (Scozia et al., 2023). EEG studies (Vallesi et al., 2011) have identified the correlates of the STEARC in the inter-hemispheric competition for the selection between left vs right manual responses to short/long time intervals, that is reflected in the amplitude of the Lateralized Readiness Potential (LRP). We investigated whether variations in the strength of the STEARC, as a function of RTs speed, are reflected in variations in LRP amplitude. Most important, we examined whether the emergence of the STEARC at slower RTs is preceded by changes in EEG components associated with temporal encoding during, around or immediately after the offset of time intervals. Although these components cannot be retrospectively modulated by the STEARC, changes in their amplitude and latency may reveal early neural precursors of the STEARC. We found that spatial engagement in timekeeping follows the insufficient non-spatial encoding of time intervals, leading to delayed decisions on their length. These findings provide the first clear evidence of when, why, and how the brain recruits spatial mechanisms in the service of temporal processing and demonstrate that non-spatial and spatial timekeeping systems can be dissociated at both behavioural and electrophysiological levels.Scozia et al. (2023) Cortex *164*, 21–32. https://doi.org/10.1016/j.cortex.2023.03.009Vallesi et al. (2011) *Cortex*, *47*(2), 148–156. https://doi.org/10.1016/j.cortex.2009.09.005

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