Attentional Volleying Across Visual Quadrants

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Introduction: In 1937, Ernest Wever and Charles Bray proposed the Volley Theory to explain how comparatively sluggish neural firing rates might register high auditory frequencies. The theory posits that distinct neural ensembles synchronize at various temporal phases to increase an organism's temporal precision. This neural-ensemble volleying might more broadly be construed as a general neural principle that helps organisms solve time-based problems via biologically manageable episodes. Here, we investigated whether neural resources that govern attention to each visual quadrant might volley to improve temporal precision beyond the canonical ~7.5 Hz limit (VanRullen, Carlson & Cavanagh, 2007).

Method: Denison University undergraduates viewed four-stream RSVP displays containing two targets (T1 and T2) and reported the identity of each target on each trial. Randomly across trials, the four streams flashed either synchronously at 7.5 Hz, or asynchronously with new information occurring at 7.5 Hz per quadrant, 15 Hz per lateral hemifield, and 30 Hz globally. In a flicker-discrimination control experiment participants viewed 4-stream displays presented simultaneously or in quadrature phase at 15 or 30 Hz, and reported whether the streams flashed synchronously or asynchronously.

Results: The synchronous and asynchronous conditions generated statistically indistinguishable, near-ceiling T1-identification accuracy despite the asynchronous condition's 30 Hz global presentation rate, i.e., four times the canonical ~7.5 Hz attention rate. Similarly, the asynchronous condition reduced T2|T1 accuracy by just 4.5 percentage points, a cost only half that associated with the moving T2 from the left to right visual field. These null and small effects occurred even though participants reliably discriminated synchronous from asynchronous displays at 15 and 30 Hz.

Conclusion: Our experiments reveal accurate visual attention for spatially distributed targets presented at four times the canonical ~7.5 Hz limit. This supports the possibility that the neural events governing attention to each visual quadrant volley to improve attention's temporal precision.

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