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Pupillometric signature of implicit learning of statistical regularities

Saturday, September 13, 2025 1:10 PM (20 minutes)

Animals learn about the statistical regularities of their environment by a process of implicit learning, a powerful mechanism that may operate by mere exposure.1 Implicit learning supports processes such as speech acquisition but also learning about the spatial and temporal structure of the world more generally, which is essential for effective interaction.2 Here, we used a frequency-tagging technique to demonstrate a pupillometric signature of the learning of the temporal structure (pairing of numerosities) of sequential arrays. Although the numerosity pairings were unnoticed by all participants, the pupil responded clearly to their repetition frequency (1 Hz). Pupillometry allowed us to track the learning as it unfolded (the response became significant after less than 3 min of passive viewing), without ever directing attention to the temporal structure of the stimuli. Diverting attention away from the numerosity feature did not prevent learning, but it did affect the dynamics of the response acquisition. A clear pupillometric response was also elicited by pairing dyads of digits. In all our stimuli, the local features were randomized, implying that learning successfully generalized across stimuli that were locally different and only acquired a temporal structure once their global statistics (overall shape or numerosity) were extracted.

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No

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