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Deforming the metric of cognitive maps distorts memory

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Environmental boundaries anchor cognitive maps that support memory. However, trapezoidal boundary geometry distorts the regular firing patterns of entorhinal grid cells proposedly providing a metric for cognitive maps. Here, we test the impact of trapezoidal boundary geometry on human spatial memory using immersive virtual reality. Consistent with reduced regularity of grid patterns in rodents and a grid-cell model based on the eigenvectors of the successor representation, human positional memory was degraded in a trapezoid compared to a square environment; an effect particularly pronounced in the trapezoid's narrow part. Congruent with spatial frequency changes of eigenvector grid patterns, distance estimates between remembered positions were persistently biased; revealing distorted memory maps that explained behavior better than the objective maps. Our findings demonstrate that environmental geometry affects human spatial memory similarly to rodent grid cell activity — thus strengthening the putative link between grid cells and behavior along with their cognitive functions beyond navigation.

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