Global scene similarity structure predicts memory performance

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Memory for low-level features such as color and orientation can be explained using a signal-detection model that takes into account perceptual similarity (Schurgin, Wixted, Brady, 2018). Such similarity falls off as an approximately exponential function of distance in perceptual space, similar to the extent of overlap in corresponding neural populations. Can perceptual similarity judgements for higher-level representations such as scenes predict scene memory? In scenes, similarity judgments and memory must depend on much richer representations than simple overlap in a single neural population (e.g., categorization depends on function: Greene et al. 2016; memory on conceptual overlap: Konkle et al. 2010).

In order to assess this, we created a new continuous scene space database by extracting temporally evenly spaced frames from videos shot from drones, resulting in 100 unique categories with a gradient of similarity of scenes in each. In a similarity task, we presented N=100 UCSD undergraduate participants with two images at a time and asked them to rate their similarity on a continuous scale. As expected, similarity judgments were complex and not well explained by simple low-level feature overlap, though global measures such as color histograms and histograms of oriented gradients did predict significant amounts of similarity variance. In order to see if similarity ratings predict memory confusability, we then conducted an independent memory experiment (N=200) on Prolific, where participants viewed 100 categorically distinct images and then did a 2-AFC memory test. We found that participants' judgements of similarity explained almost 50% of the explainable variance in memory performance ($p<0.0001$).

Thus, memory confusability is linearly predicted by independent similarity ratings, even though both are themselves complex, depending on functional and conceptual features rather than perceptual features. This is broadly consistent with the case of simple features, as well with theories of recognition memory that depend on similarity (e.g., Nosofsky, 1992).