Quantifying the resolution and capacity of memory during free recall of real-world visual scenes

Elizabeth H. Hall, Wilma A. Bainbridge & Chris I. Baker
Laboratory of Brain and Cognition, National Institutes for Mental Health

Prior research has shown that visual long-term recognition memory has a massive storage capacity for object details, with participants able to maintain detailed representations of thousands of images (Brady et al, 2008). However, little work has examined the capacity and resolution of free recall for complex visual images, in spite of evidence that recognition and recall may utilize separate neural mechanisms (Staresina & Davachi, 2006). The current study investigates recall of real-world scenes, and how this relates to recognition-based metrics of memory (i.e., *image memorability*). We selected three images each for 30 categories of real-world scenes - images determined in a separate online memory study to have high, medium, and low memorability (Isola et al, 2011; Bylinskii et al, 2015). Participants (n=30) were shown 30 real-world scenes (15 high memorability, 15 low memorability) for 10 seconds each, followed by a 7 minute digit-span delay task meant to disrupt working memory, before being asked to recall those images and draw/describe them in detail. Participants then completed a recognition task, indicating old/new and confidence for the original images intermixed with 30 matched foil images of medium memorability. The recall task revealed that participants had a memory capacity for real-world scenes of 12.31 out of 30 scenes on average, higher than the typical capacity found in verbal recall. There was no correlation between digit span and scene recall performance ($r=0.1436$, $p=0.4331$) or digit span and recognition performance ($r=0.1747$, $p=0.339$), suggesting that memory capabilities differ by stimulus and task type. Higher hit rates were recorded for memorable scenes over forgettable scenes in the recognition task, supporting the finding that memorability is an intrinsic stimulus property that can predict performance in recognition (Bainbridge et al., 2013). In contrast, there was no significant correlation between memorability and recall performance. Analyses quantifying the specific details participants remembered in each image showed some consistencies across participants in which objects within a scene they tended to remember. Overall, these results provide insight into the capacity and detail with which people recall complex visual images, and provide evidence for fundamental differences between recall and recognition.