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A normative theory of visual working memory limitations

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Abstract: There are many benefits to having a highly accurate representation of the environment. Why, then, has evolution equipped us with a visual working memory (VWM) system that can represent only a handful of items with high accuracy? Here, we offer a normative explanation for this limitation by conceptualizing VWM as a system that balances between two conflicting goals: keeping memory errors small and spiking activity low. We formalize this trade-off in a loss function and show that minimization of loss dictates a strategy in which memory precision declines with the number of remembered items. Using psychophysical data from 67 human subjects in 5 delayed-estimation experiments, we show that this normative model provides an excellent account of human VWM limitations. These results suggest that human VWM implements an optimal compromise between two conflicting ecological goals.