Integrating and attending to information in a complex world

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The theoretical and empirical study of cue combination has mostly focused on perceptual behaviour in simple situations where sensory input is dominated by two, or at most a few, salient "cues". In more complicated environments, however, objects, attributes, and associated cues, abound; and cue combination is inextricably linked with the problems of parsing and binding. In the simple situations that have been studied, behaviour often appears to be optimal, following probabilistic principles of integration and of Bayesian model selection. We argue, however, that in the more complex setting, the computational and representational demands of Bayesian inference grow exponentially with the number of available cues, and thus rapidly become intractable, necessitating approximation. We suggest a form of approximate inference, borrowed from the theory of probabilistic graphical models, which is consistent with neurophysiology and with behaviour. Furthermore, we propose that the resulting approximations may be refined locally through the action of sensory attention, which thus (in a probabilistic echo of Feature Integration Theory) plays a central role in the integration of associated cues.