**The algorithm**

Our strategy applies to any identification task with an additive target in white noise backgrounds and has the potential to generalize to different environments. We start by characterizing the set of visual patterns the study concerns. In the present case, it is a set of raised cosine windowed sine waves with different orientations and scales. Then, we identify the computationally intense operations involving images. Equation 3 (in the paper) reveals that subcategory likelihood ratios only depend on the image through template responses, which are the dot products between templates and images.

For each image described by its subcategory , category , and context level , the normalized template responses are the collection of subcategory template responses . Next, we identify a basis simulation in which we calculate basis template responses that makes it possible to calculate the normalized template responses for various image properties without recalculating the dot-products. In this case, we precomputed the basis template responses to white noise backgrounds with a standard deviation of 1.0 with no target . In this case, the expression below that describes the template responses of images with different properties in terms of basis template responses also involves the d-prime of the presented target , and the dot product between the template of the presented target , and all the templates. Thus, we precomputed the dot products of all possible pairs of templates when all templates were set to an amplitude of 1.0. In the pre-computation stage, we saved the basis template responses and dot-products between templates.

The saved variables of the pre-computation stage can now be used to evaluate the ideal and heuristics observers’ performance under various configurations categories and subcategories as long as they only involve a pre-defined set of visual patterns. We can evaluate the models under lower levels of extrinsic uncertainty and for various tasks (detection, discrimination) through proper configurations. Moreover, we can change the prior probabilities, target amplitudes, and background contrast associated with the simulation without computing any additional dot products.