Failure of Deep Networks at Recognizing Objects in Visual Noise: Comparisons with Human Behavioral Performance

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Presentation Abstract Summary Convolutional neural networks (CNNs) have attracted considerable attention for their remarkable performance at object recognition tasks. This has led to the proposal that CNNs have attained near human levels of performance. Although CNNs provide a biologically plausible model of object recognition, it remains an open question as to whether CNNs process visual information in a manner that closely resembles the human visual system. In this study, we evaluated human observers and CNNs at recognizing objects in varying levels of visual noise, testing for quantitative and qualitative differences in performance. To this end, recognition performance was evaluated using two different types of noise: Gaussian pixelated noise and Fourier phase-scrambled noise. As predicted, human recognition was generally more robust to visual noise than CNN performance. More striking, we observed qualitative differences in visual processing: Gaussian pixel noise caused much more severe impairment to CNNs, while human observers exhibited greater difficulty with Fourier phase-scrambled noise. Further experiments revealed minimal improvement in CNN performance following extended training with noisy images. Our findings demonstrate that human visual processing is qualitatively different from CNN performance, and far more robust to Gaussian pixel noise than is currently feasible for standard feedforward CNN architectures.

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