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Inverse Rendering Best Explains Face Perception Under Extreme Illuminations

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Abstract

Humans can successfully interpret images even when they have been distorted by significant image transformations. Such images could aid in differentiating proposed computational architectures for perception because while all proposals predict similar results for typical stimuli (good performance), they differ when confronting atypical stimuli. Here we study two classes of degraded stimuli – Mooney faces and silhouettes of faces – as well as typical faces, in humans and several computational models, with the goal of identifying divergent predictions among the models, evaluating against human judgments, and ultimately informing models of human perception. We find that our top-down inverse rendering model better matches human percepts than either an invariance-based account implemented in a deep neural network, or a neural network trained to perform approximate inverse rendering in a feedforward circuit.