Through a glass brightly: seeing beyond the surface in image quality

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Images have always presented a puzzle for perceptual scientists because they serve as visual representations of objects while also being objects themselves. Much effort has gone toward understanding how images represent the three-dimensional properties of objects, and there is now some understanding of the relations between the geometric projections used in image rendering and the perceived shapes of depicted objects. Considerably less effort has focused on how images convey other properties of objects such as material properties and textures, though there is a vast literature on image quality that purports to speak to these issues. The premise of this project is that much of the work on image quality is misguided because it conflates the properties of images as signals with the properties of images as visual representations. In a series of experiments we have investigated the ability of conventionally low quality (noisy, low contrast, blurry) images to faithfully represent the material properties of objects. Contrary to the predictions of standard image quality metrics, we find that the ability of these images to faithfully represent material properties, as measured by Thurstonian scaling, is not much reduced by these distortions. It is as if observers are able to see through the image plane distortions to correctly perceive the material properties of the depicted objects. On the basis of these experiments we are developing new image quality metrics that take into account recent findings on the role of light reflection statistics in material perception, and analyze interactions between the statistics of light structuring by materials and the statistics of image coding distortions, to better predict how well images with different signal properties serve as visual representations of the objects they depict.