



Figure 15.5: An autoencoder trained with mean squared error for a robotics task has failed to reconstruct a ping pong ball. The existence of the ping pong ball and all of its spatial coordinates are important underlying causal factors that generate the image and are relevant to the robotics task. Unfortunately, the autoencoder has limited capacity, and the training with mean squared error did not identify the ping pong ball as being salient enough to encode. Images graciously provided by Chelsea Finn.

of a robotics task in which an autoencoder has failed to learn to encode a small ping pong ball. This same robot is capable of successfully interacting with larger objects, such as baseballs, which are more salient according to mean squared error.

Other definitions of salience are possible. For example, if a group of pixels follow a highly recognizable pattern, even if that pattern does not involve extreme brightness or darkness, then that pattern could be considered extremely salient. One way to implement such a definition of salience is to use a recently developed approach called **generative adversarial networks** (Goodfellow *et al.*, 2014c). In this approach, a generative model is trained to fool a feedforward classifier. The feedforward classifier attempts to recognize all samples from the generative model as being fake, and all samples from the training set as being real. In this framework, any structured pattern that the feedforward network can recognize is highly salient. The generative adversarial network will be described in more detail in section 20.10.4. For the purposes of the present discussion, it is sufficient to understand that they *learn* how to determine what is salient. Lotter *et al.* (2015) showed that models trained to generate images of human heads will often neglect to generate the ears when trained with mean squared error, but will successfully generate the ears when trained with the adversarial framework. Because the ears are not extremely bright or dark compared to the surrounding skin, they are not especially salient according to mean squared error loss, but their highly