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Authors

Pincus, Jared

Suchow, Jordan

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An empirical estimate of the dimensionality of face space

Jared Pincus

Stevens Institute of Technology, Hoboken, New Jersey, United States

Jordan Suchow

Stevens Institute of Technology, Hoboken, New Jersey, United States

Abstract

Learned generative models of human identity and appearance are typically high dimensional. However, social perception of faces is low dimensional. What is the dimensionality of face space in the mind of an observer? To estimate this dimensionality, we begin with a simple observation: for any given person, there are many unrelated people who look similar to them. Next, we note that the very concept of strong resemblance exists only in low-dimensional spaces; in high-dimensional spaces, even nearest neighbors are far apart. Therefore, face space is of low dimensionality. How low? Using the scaling relationship between dimensionality and n th-nearest-neighbor distances, we empirically estimate the dimensionality of face space by measuring the ratio of JNDs between random pairs of faces and faces paired with their nearest neighbors. We empirically estimate this ratio to be 0.76 [0.73, 0.79; 90% CI], which implies a dimensionality of human face space between 7 and 12 dimensions.