Social Networks: Analyzing Social Information in Deep Convolutional Neural Networks Trained for Face Identification

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Social Networks

Analyzing Social Information in Deep Convolutional Neural Networks Trained for Face Identification

Human ratings of social traits for faces

- 280 face images
- Ratings collected for Caucasian 204 females, 76 males

Mean age = 80 (60 females)

Social Traits

- Humans make social trait inferences from faces readily [1] and rapidly [2]
- Trait inferences predict important decisions (e.g., voting preferences) [3]
- Social traits can be generated from models of face structure and reflectance [5, 6]

Goal 1: Measure similarity between human and computer-trait predictions from identity-train DCNN

Goal 2: Measure accuracy of trait predictions using DCNN features from non-frontal images

Goal 3: Predict individual social trait inferences from top-level DCNN features

Social Trait Ratings

DCNNs for Face Identification

- State-of-the-art for face identification [7] and generalizable over viewpoint, illumination, etc.
- "Top-level" DCNN features retain non-identity information (e.g., pose, image quality) [8]
- Do face-identification features also retain social information?

DCNNs modeled after primate visual cortex

- Early layers model VS/VI, final layers model IT cortex
- For face identification, final DCNN stores abstract identity code <face representation>

Identity Descriptors

- Human ratings of social traits for faces
  - 30 trait inferences
  - Ratings collected from 30 raters for 200 image pairs, first 150 full-face, last 50 frontal

Verify Structure of Face Trait Space (e.g. [5])

- N x K "feature matrix" obtained from DCNN
  - N = n x K "trait sets" obtained from averaged participant responses
  - Estimate of final trait predictions from feature matrix using linear regression

Individual Trait Predictions

- Error between human ratings and predicted traits, plotted against a null distribution
  - All traits predicted significantly above chance

Conclusions

Conclusion 1

- Human trait inferences can be predicted from the top-level features of a DCNN trained for face identification

Conclusion 2

- Trait inferences assigned to frontal faces can be predicted from DCNN features generated for both frontal and non-frontal faces

Conclusion 3

- Top-level DCNN features for face identification retain robust trait representation – each individual trait predicted above chance

References


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