Modeling the Moderation of Experience in Face and Object Recognition

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Introduction

Is face recognition *independent* of non-face object recognition? While some work suggests so based on little correlation exists between performance on CFMT and non-face object recognition, Gauthier et al. (in press) challenged is idea by arguing that a *domain general visual ability (v)* underlies both face and object recognition, and this ability is expressed in full when there people have sufficient *experience (E)* in that category. In this work, we account for Gauthier et al.'s result using a neurocomputational modeling approach: The Model (TM, Cottrell and Hsiao (2011)).

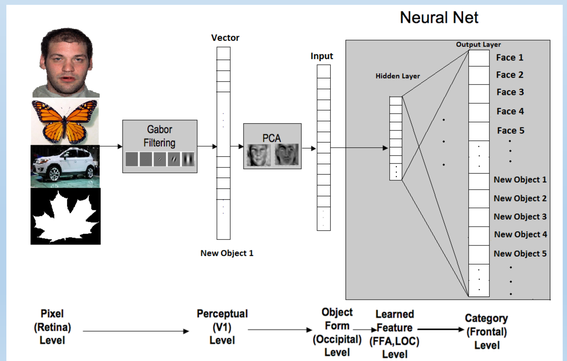


Figure 1. Model Architecture of TM

The Experiment

Gauthier et al. (in press)'s psychological experiment:

- From 256 human subjects, collect their self-rating (1 to 9) of the expertise with the VET object categories (O-EXP).
- Split the human subjects into 6 groups based on their self-ratings, measure their face recognition performance using CFMT.
- Measure the subject's non-face object recognition ability using VET for 8 categories (O-PERF).
- Compute the correlation between CFMT score and O-PERF.

The Model

In our model (TM), for each subject network s_{net}:

- We map domain general visual ability (v) to the number of hidden units, as more hidden units mean for more resources for training a neural network.

$$N_{hidden}(s_{net}) = floor(8 \times CFMT(s_{human}))$$

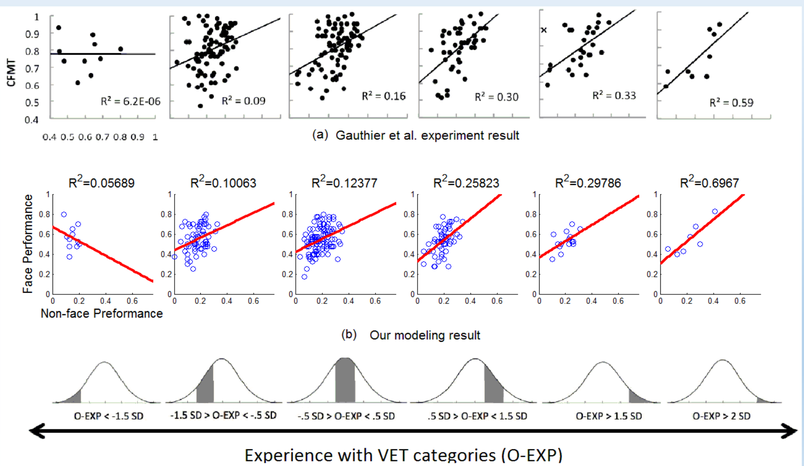
- We map experience (E) to the number of training epochs on non-face object categories in TM.

$$N_{epoch}(s_{net}) = 8 \times O{-}EXP(s_{human})$$

- We then run the following procedure for each subject network:
  1. Train on faces (10 individuals) for 200 epochs.
  2. Start from the weights after face network training, train face and non-face object categories together.
  3. Measure performance on both faces and non-faces.
- We finally calculate correlation between performance on face and non-face categories across all subject networks as a function of experience.

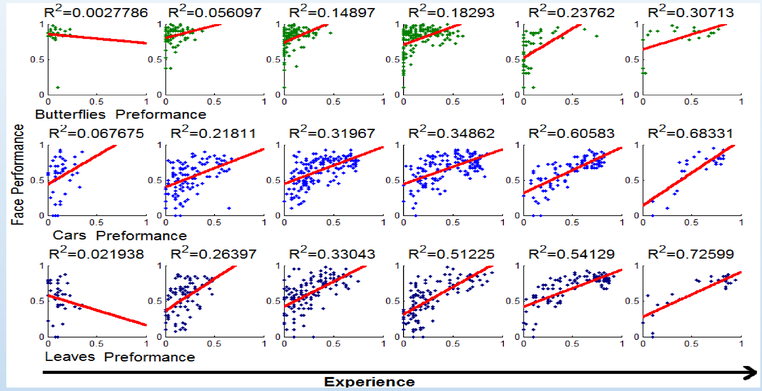
Experiment 1

Modeling the experiment of Gauthier et al.'s (in press) using averaged non-face object category performance

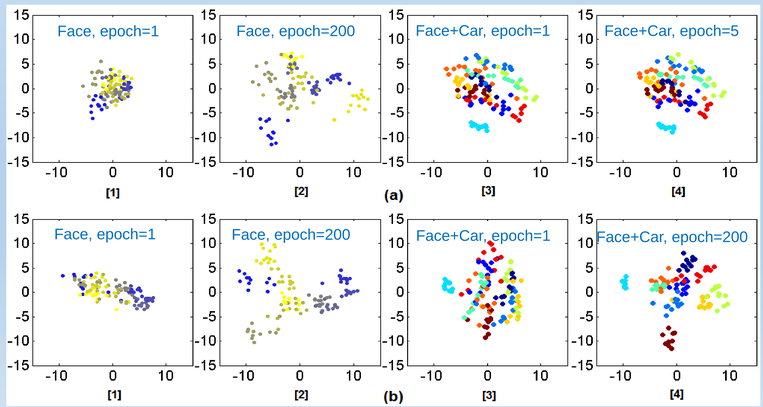


Experiments 2

- Measure correlation between CFMT score and single non-face object category performance



- Analyze the power of experience by looking into hidden unit activation



Conclusion

- Our modeling work shows the shared variance between the performance on faces and the performance on subordinate-level object categorization increases as experience grows.
- Our results suggest that a potential source for the variance in the "domain general ability" between individuals is the amount of representational resources available for fine-level discrimination.
- Our analysis shows that face and objects share a "spreading" transform, suggesting this is why FFA is recruited by new categories of expertise.

References:

- Cottrell, G. W., & Hsiao, J. H. (2011). Neurocomputational models of face processing. In A. J. Calder, G. Rhodes, M. Johnson, & J. Haxby (Eds.), The Oxford Handbook of Face Perception. Oxford, UK: Oxford University Press.
- Gauthier, I., McGugin, R. W., Richler, J., Herzmann, G., Speegle, M., & Gulick, A. E. V. (in press). Experience moderates overlap between object and face recognition, suggesting a common ability. Journal of Vision.