Classification Images Measured in a Same/Different Face Discrimination Task

Patrick J. Bennett[1,2,3,4], **Matthew Pachai,**[1,2] **& Allison B. Sekuler**[1,2,3,4]

1. Department of Psychology, Neuroscience and Behaviour, McMaster University, Hamilton, Ontario, Canada; 2. CIHR Strategic Training Program in Communication and Social Interaction in Healthy Aging; 3. CIHR Research Group on Sensory and Cognitive Aging; 4. Centre for Vision Research, York University, Toronto, Ontario, Canada

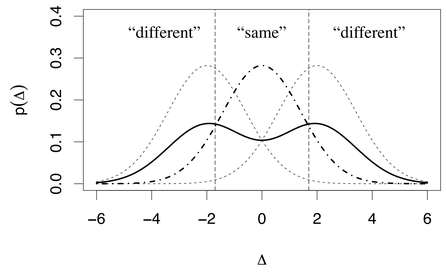
Introduction

Goal

Devise a simple method for deriving a classification image from data collected in a same-different task.

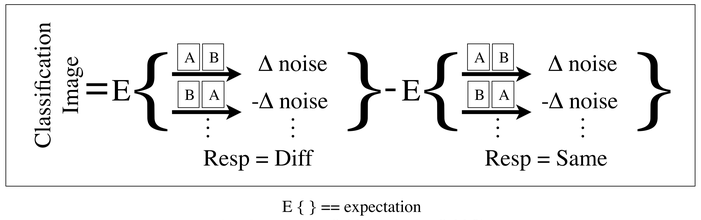
Problem

The decision space for the same-different task is quadratic: internal responses that are positive and negative can cause the observer to respond "different". Therefore, traditional methods of estimating a classification image do not work.



Solution

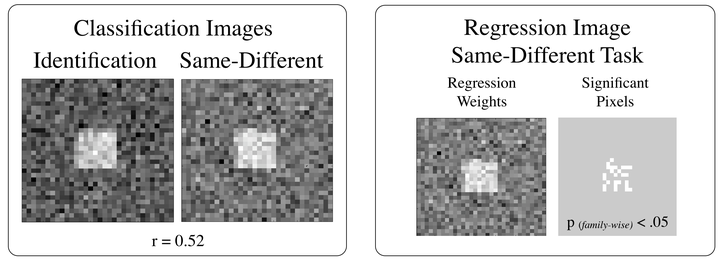
We analyze data only from trials on which the stimuli differed. On such trials, noise fields that are positively correlated with those aspects of the stimuli that influence behaviour should increase the probability of responding "different". Furthermore, noise fields that increase "different" responses on <A,B> trials will be anti-correlated with the same type of noise fields on <B,A> trials.



E { } == expectation
Δ noise = (noise field 1) - (noise field 2)

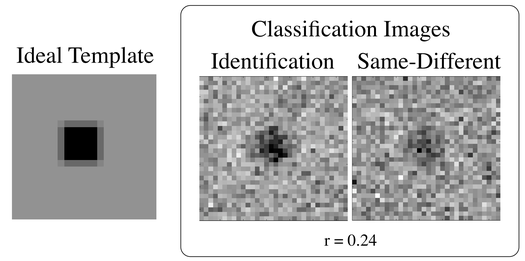
Contrast Polarity Discrimination

Simulations



Simulations estimated the linear template used by an ideal detector in a 1-interval identification task and a same-different task. All 5,000 simulated trials were used to estimate the classification image in the identification task, whereas only 2,500 trials from the same-different task were used to estimate the template. Correlations between classification images derived from multiple simulations of the identification task were approximately 0.70. When the number of trials was reduced from 5,000 to 2,500, the correlation between classification images was approximately 0.57.

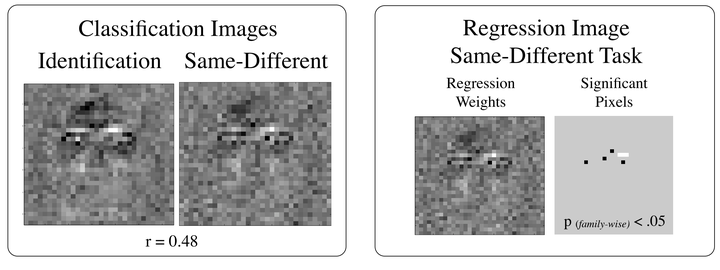
Experiments



- Stimuli: black & white squares embedded in white, static Gaussian noise
- Two tasks: 1-interval identification ("black" or "white") & same-different
- Stimulus Duration = 100 ms
  - Same-Different: ISI = 500 ms
- Contrast adjusted with a 2-down/1-up staircase procedure
- Several thousand trials in each task

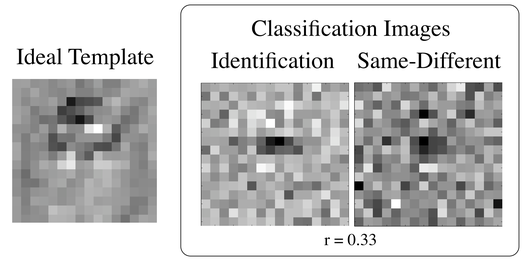
Face Discrimination

Simulations



Correlations between classification images derived from multiple simulations of the identification task were approximately 0.66. When the number of trials was reduced from 5,000 to 2,500, the correlation between classification images was approximately 0.52.

Experiments



- Stimuli: two male faces embedded in white, static Gaussian noise
- Two tasks: 1-interval identification & same-different
- Stimulus Duration = 100 ms
  - Same-Different: ISI = 500 ms
- Contrast adjusted with a 2-down/1-up staircase procedure
- Several thousand trials in each task

Conclusions

- it is possible to derive "classification images" from same-different data
  - provide good estimates of linear templates used by simulated observers
  - similar to standard images obtained from human observers
- more work is needed to:
  - extend method to same-different task using more than two stimuli
  - compare method to related computational approaches (see references)

References

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- Schwartz, O, Pillow, JW, Rust, NC, & Simoncelli, EP (2006). *J. Vis.*, 6(4), 484-507.
- Sharpee, T, Rust, NC, Bialek, W (2004). *Neural Comput.*, 16(2), 223-50.

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For more information, please contact the first author at bennett@mcmaster.ca