Understanding face detection with visual arrays & real-world scenes

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Introduction

Detecting faces is important for conveying social information. Detection is most rapid when faces are presented upright, in colour, and with the correct height-width ratios (Bindemann & Burton, 2009; Pongakkasira & Bindemann, 2015) and performance declines when these conditions are not met.

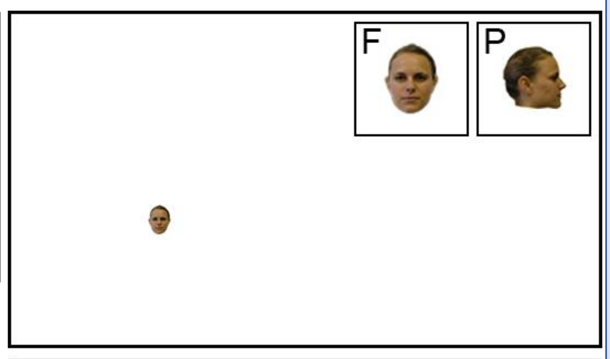
Research on face detection involves a range of approaches in displaying face stimuli. The three main presentations are on blank displays, in an array of objects, or embedded within a scene.

Each approach has it's own implications on research findings. Detection advantages appear in arrays but not blank displays (Hershler, Golan, Bentin & Hoshstein, 2010). Frontal and profile faces are detected equally on blank displays but a frontal face advantage appears with visual scenes (Bindemann & Lewis, 2013).

This research investigates the influence of display context on face detection by comparing differing face stimuli.

Experiment 1

Experiment 1 examined the detection of frontal and profile faces across each display type (Blank, Array, Scene).

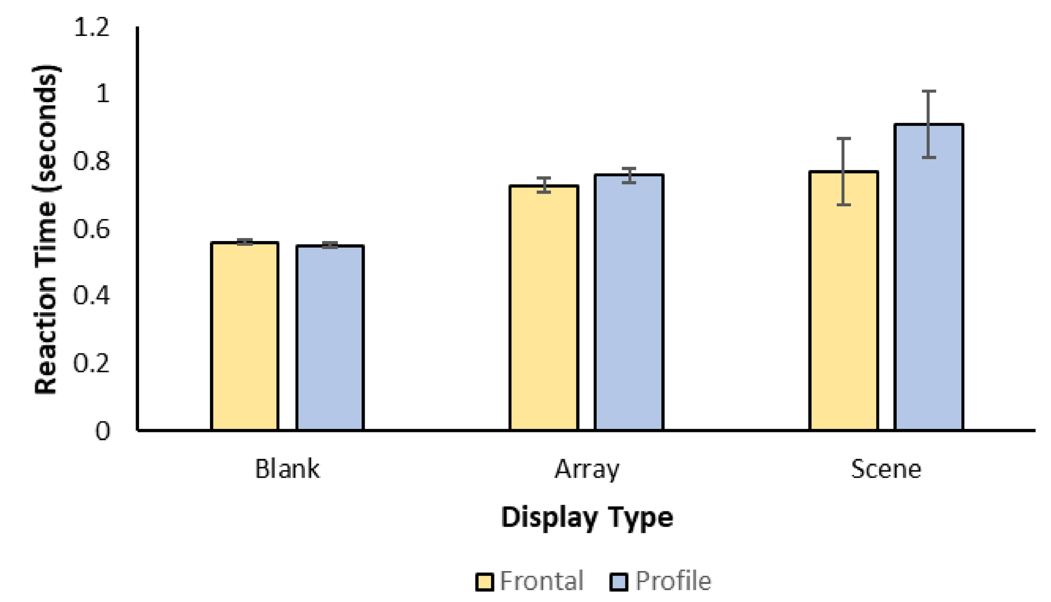


- 43 participants
- 8 frontal & 8 profile
- Presented on either
  - Blank Background
  - Within an Array
  - Within a Scene.
- Faces appeared in one of 24 locations
- Trials were either face present or absent

Participants were presented with 144 trials.

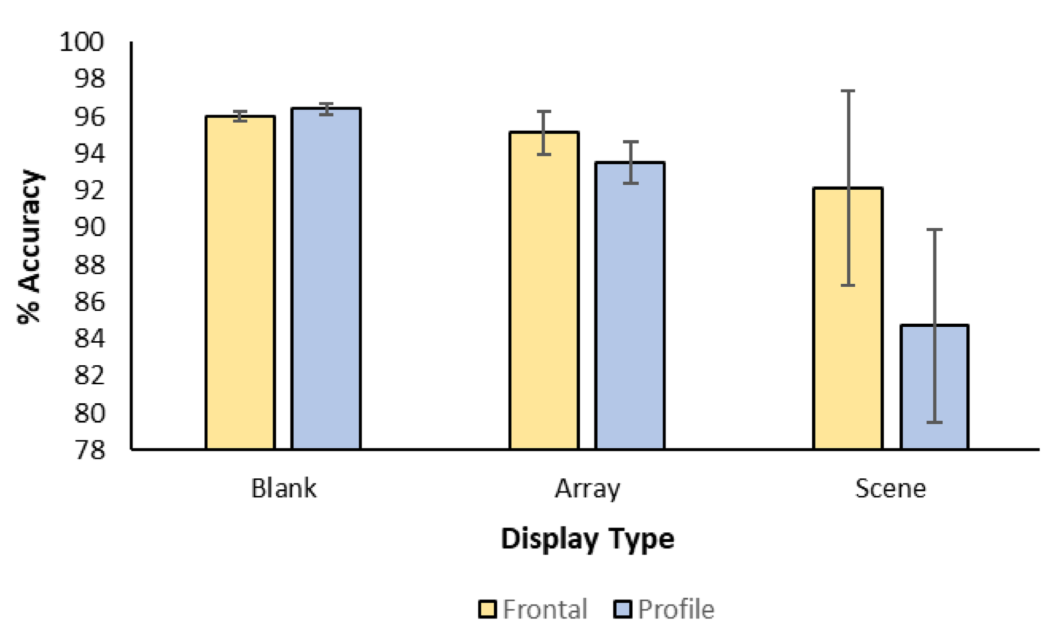
Results

RTs for Face Type*Display Type



- Frontal faces were detected faster than profile faces in the scene displays, $p < .001$, but not in blank displays, $p = .46$, or arrays, $p = .19$.

Accuracy for Face Type*Display Type

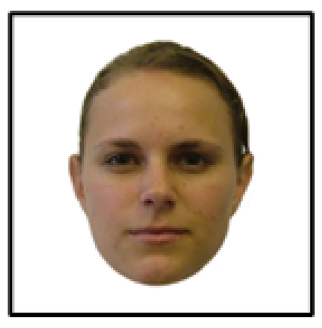


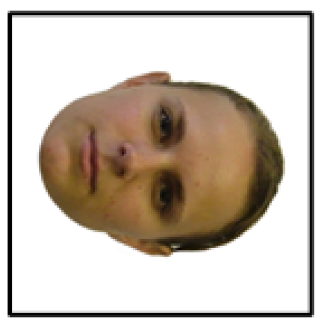
- Accuracy was higher for frontal faces than profile faces with scene displays, $p < .001$, but not blank displays, $p = .99$, or arrays, $p = .58$.

Experiment 2

Experiment 2 replicates the experiment 1, but controls for face shape and saliency.

Experiment 2 examines the detection of upright and rotated faces across each display type (Blank, Array, Scene).



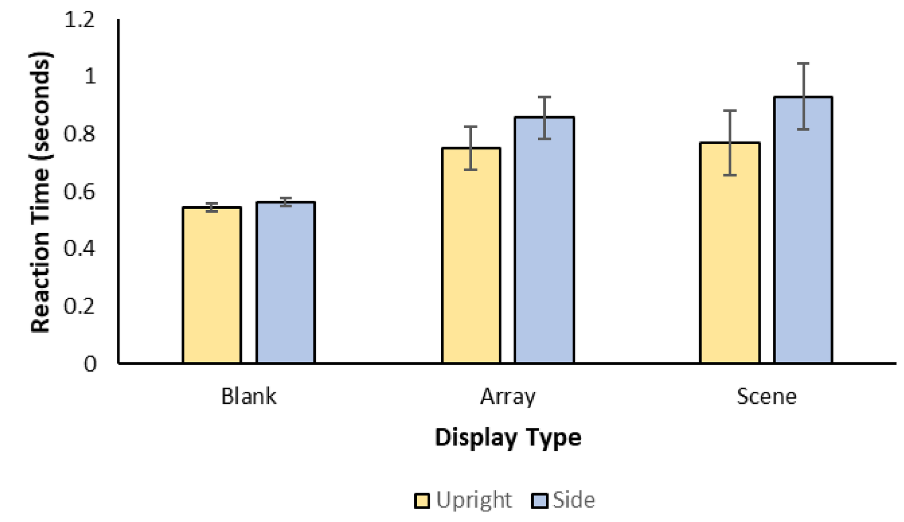


- 30 participants
- 8 upright & 8 rotated

Same procedure

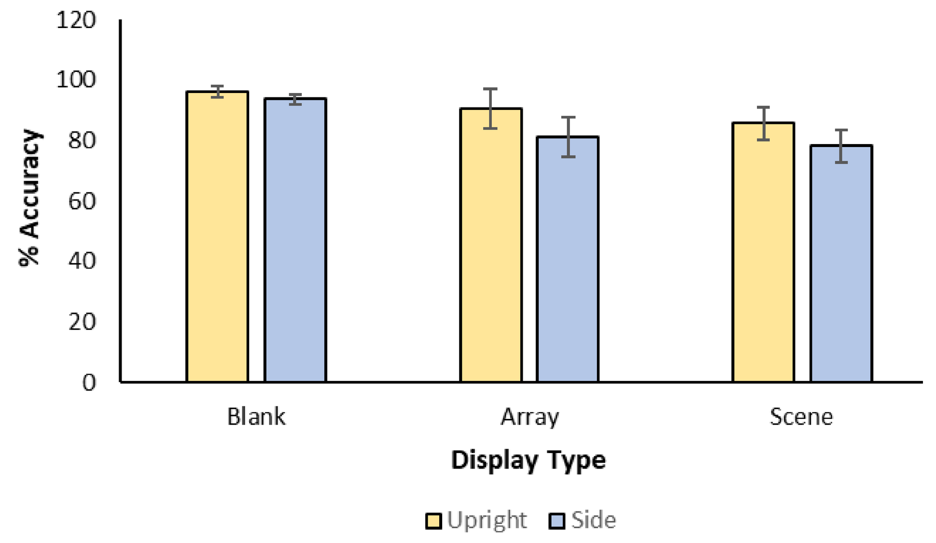
Results

RTs for Face Type*Display Type



- Upright faces were detected faster than rotated faces in arrays, $p = .002$, and scenes, $p < .001$, but not in blank trials, $p = .39$.

Accuracy for Face Type*Display Type

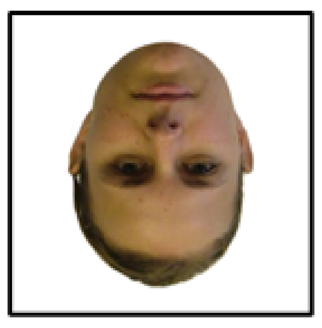


- Accuracy was higher for upright than rotated faces in arrays, $p < .001$, and scenes, $p = .03$, but not in blank displays, $p = .41$

Experiment 3

Experiment 3 further investigates the role of face shape.

Experiment 3 examines the detection of upright and inverted faces across each display type (Blank, Array, Scene).

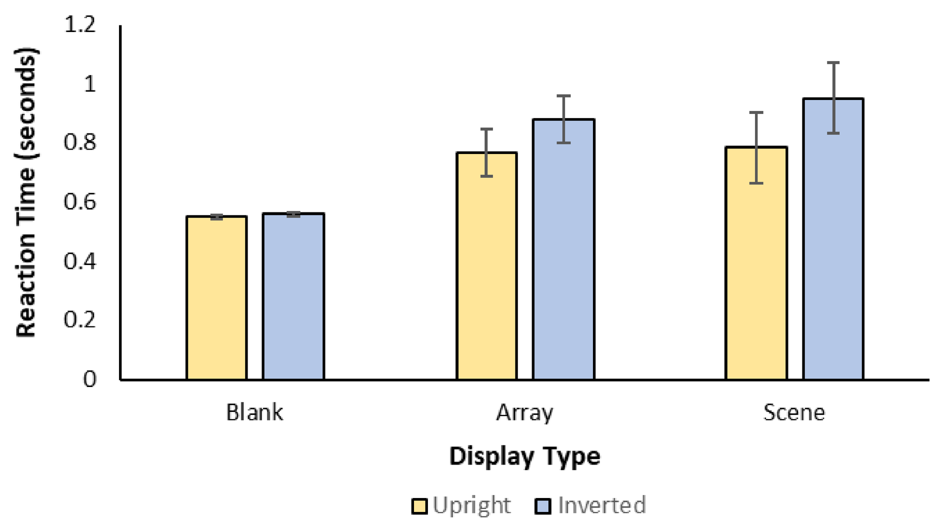


- 30 participants
- 8 upright & 8 inverted

Same procedure

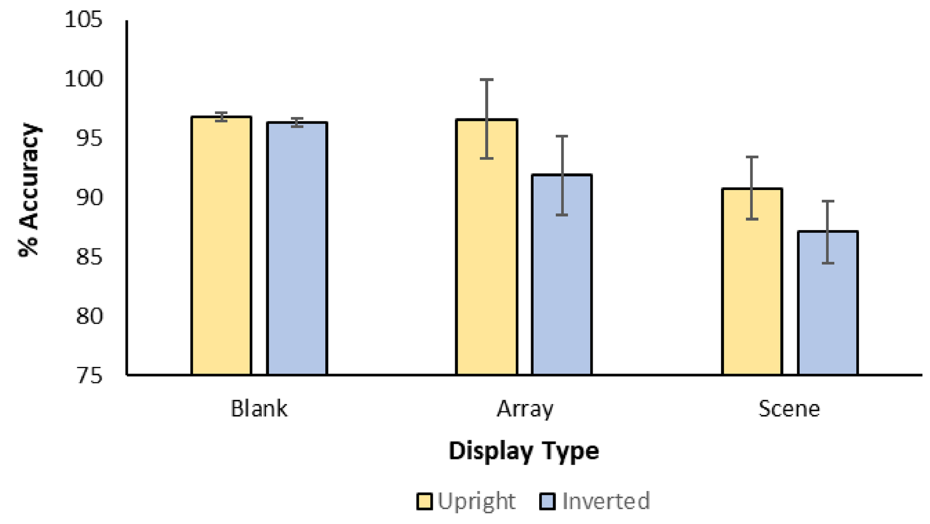
Results

RTs for Face Type*Display Type



- Upright faces were detected faster than inverted faces in arrays, $p < .001$, and scenes, $p < .001$, but not in blank displays, $p = .46$.

Accuracy for Face Type*Display Type

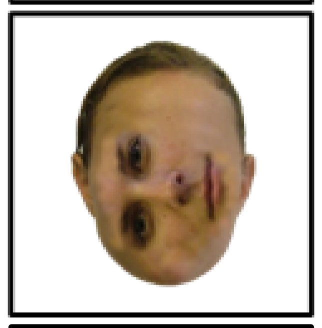


- Accuracy was higher for upright faces than inverted faces in arrays, $p < .001$ and scene displays were also approaching significance, $p = .06$, but there was no difference in blank displays

Experiment 4

Experiment 4 manipulates internal and external features separately to create hybrid faces.

Experiment 4 examines the detection of upright, external-upright, and internal-uptight faces across each display type (Blank, Array, Scene).



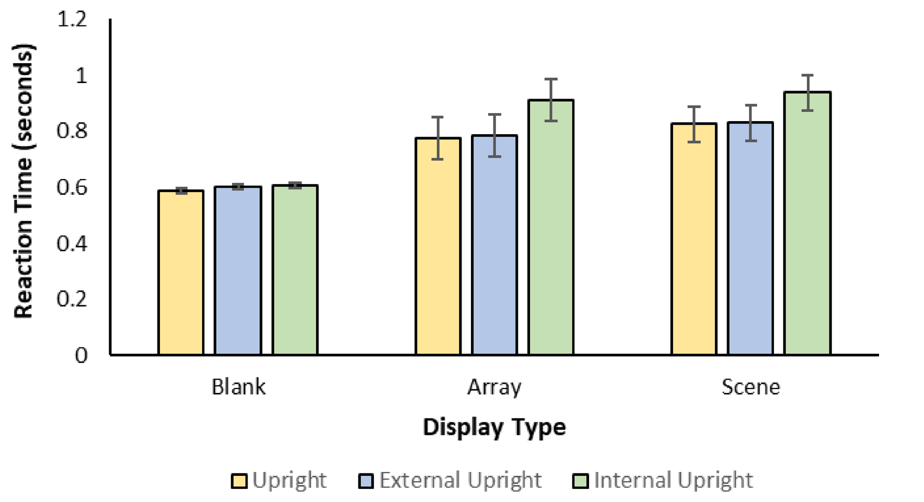
- 46 participants
- 8 upright, 8 external-upright & 8 internal-upright

For external-upright faces, the internal features were rotated. For internal-upright faces, the external features were rotated.

Same procedure except there were 432 trials, presented in 144 trial blocks.

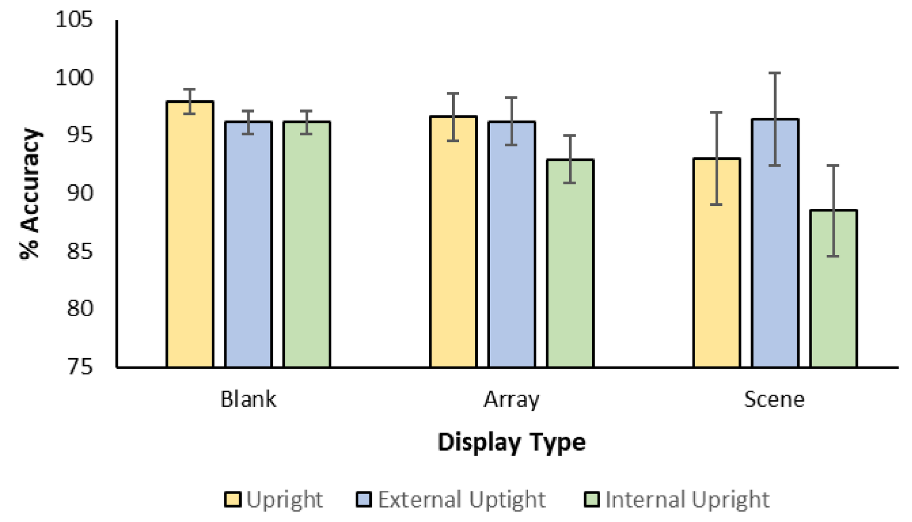
Results

RTs for Face Type*Display Type



- No difference in detection in blank displays, all $ps \geq .31$
- Upright faces and external-upright faces were detected faster than internal-upright faces in arrays and scenes, all $ps < .001$,
- Detection was similar for upright faces and external-upright faces in array and scene display conditions, both $ps \geq .94$

Accuracy for Face Type*Display Type



- Accuracy was similar in blank displays, all $ps \geq .81$
- For arrays and scenes, both upright faces and external-upright faces were detected more accurately than internal-upright displays, all $ps < .05$
- Detection accuracy was similar for the upright and external-upright conditions in arrays, $p = 1.00$

Discussion

This research demonstrates that display type influences face detection:

- Frontal upright faces were compared to profile, rotated, inverted, inter-upright and external-upright faces in blank, array and scene displays.
- Detection was comparable in blank displays, but a disparity emerges in array and scene displays.

This also provides insights on the facial characteristics that are important for detection.

- Experiments 1, 2 and 3 demonstrate the importance of face shape and features in detection.
- Experiment 4 demonstrates the importance of external features in detection over internal features.
- This supports a colour-shape template in face detection.

References

- Bindemann, M., & Burton, A. M. (2009). The role of color in human face detection. *Cognitive Science*, *33*(6), 1144-1156.
- Bindemann, M., & Lewis, M. B. (2013). Face detection differs from categorization: Evidence from visual search in natural scenes. *Psychonomic Bulletin & Review*, *20*(6), 1140-1145.
- Hershler, O., Golan, T., Bentin, S., & Hochstein, S. (2010). The wide window of face detection. *Journal of Vision*, *10*(10), 21-21.
- Pongakkasira, K., & Bindemann, M. (2015). The shape of the face template: Geometric distortions of faces and their detection in natural scenes. *Vision Research*, *109*, 99-106.