Learning Faces From Photographs

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Abstract

Despite the large body of research on the recognition of unfamiliar and familiar faces, how new faces become familiar remains largely mysterious. Familiar faces differ from unfamiliar faces in a number of ways including that they have been seen a number of times, and they have been seen from a number of views. Three experiments examined the effects of repeated exposures to single and multiple views. Experiment 1 revealed that multiple exposures to a single view lead to greater recognition accuracy than a single exposure, but transformations of pose or lighting still lead to poorer performance even though the photograph was now highly familiar. Experiment 2 showed that recognition accuracy across pose variations is a function of the angle of rotation away form the learned view (experiment 2). Experiment 3 examined the effect of learning two views versus a single view of a face. It was found that learning two views leads to similar accuracy on an unseen third view as learning a single view, implying that participants are learning individual photographs of a face rather than any invariant information about the face.

Introduction

Familiar faces are recognised well despite variations of lighting and pose (e.g. Bruce, 1982). Unfamiliar face recognition is in contrast, error prone after changes in pose (Bruce, 1982), lighting (Braje *et al*. 1998) and image quality (Burton *et al*. 1999).

How do faces become sufficiently familiar to display qualities such as lighting and pose invariance? Two things that are different about familiar and unfamiliar faces is that familiar faces have:

A) been seen a number of times and
B) been seen from a number of images

The face learning literature has tended to focus on providing a single exposure to a single view of a face in order to examine face learning. The experiments reported here examine the role played by repeated exposures to a face and the effects of providing more than one view of a face during learning.

Experiment 1

Does seeing a single view of a face a number of times lead to invariant recognition?

Method

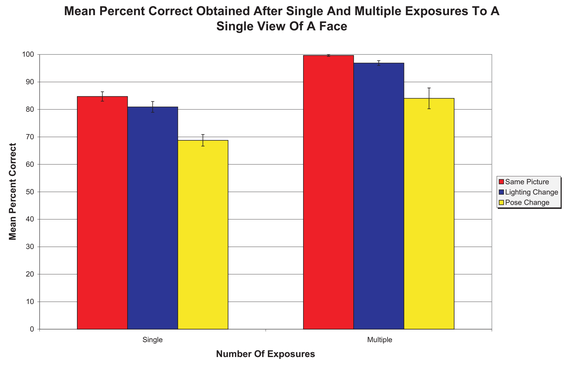
24 participants in 2 groups.

1st Phase – 12 faces seen for 5s each. Name presented with it.

2nd Phase – One group received training which required participants to name the faces. The other group did not.

3rd Phase – Both groups completed a recognition memory task for the same image plus, a change in lighting direction or a change in pose

Results



Error bars represent standard error

Results indicate that:

- multiple exposures lead to better recognition than a single exposure does
- for both single and multiple exposures, the same picture is recognised better than the lighting change which is recognised better than the pose change

No evidence that multiple exposures leads to invariant recognition.

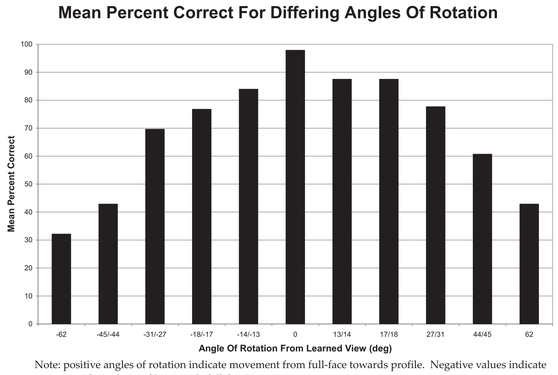
Experiment 2

Experiment 1 suggests that what is learnt is image based as opposed to invariant structural information. If structural information is extracted then the decrement to accuracy should be similar regardless of the amount of rotation of the face.

Experiment 2 examined this by training participants with a single view of a face until they could name a series of pictures of faces by name with a high degree of accuracy. Their recognition memory was then tested for the same picture, plus four other viewpoints of varying degrees of rotation (see fig. 1 for examples of the faces used).

Figure 1: examples of the five viewpoints used in experiment 2. Participants learnt a face from one of the viewpoints and were tested on all five images. The viewpoints represent (in degrees away from full-face); 0°, 17°, 31°, 44° and 62°.

Results



Note: positive angles of rotation indicate movement from full-face towards profile. Negative values indicate movement from the profile towards full-face

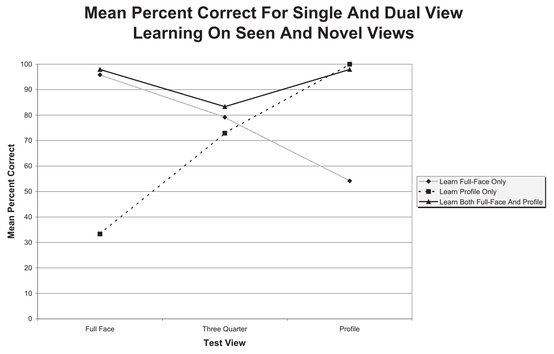
As in experiment 1, recognition accuracy for the learnt image was good. However, as the face rotated away from the learnt view, recognition accuracy decreased, suggesting that participants have learnt properties of the image as opposed to invariant structural information.

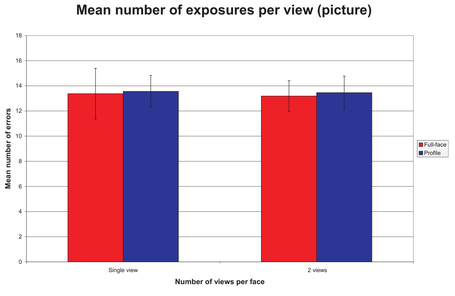
Experiments 1 and 2 suggest that participants are learning properties of the image of the face. However, as only a single view of the face is studied, participants may be unable to construct a useful 3D model of the face to aid recognition on novel views.

Experiment 3

Experiment 3 presented participants with either a single view of a face (full-face or profile) or both views during learning. If two views lead to the construction a more accurate 3D model of the face than a single view then recognition accuracy on a novel third view will be better after two views are learnt than if a single view is learnt.

Results





Results suggest that what people learn from photographs of faces is the photograph rather than any invariant structural information and people even need approximately the same number of exposures to each image, regardless of whether they are learning that face from a single view or two views.

Conclusion

Participants readily learn properties of images of faces and generalisation to novel views is conducted using these learnt images, rather than invariant structural codes. It appears that the roles of pictorial and structural coding in familiar face recognition need to be re-evaluated.

References

Braje, W., L., Kersten, D., Tarr, M. J., & Troje, N. F. (1998). Illumination effects in face recognition. *Psychobiology, 26*, 371-380
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Funded by: MRC Medical Research Council