

A new test of face discrimination

For most of us, a brief glimpse of a face is enough to judge someone's age, gender, ethnic background and to know whether or not that face is familiar. That we are so good at discriminating between faces is actually quite remarkable. After all, to a first approximation all faces are the same: two eyes, above a nose, above a mouth. Our visual system has evolved, however, to be very sensitive to subtle differences between faces and we are extremely accurate at recognising faces that are familiar to us.

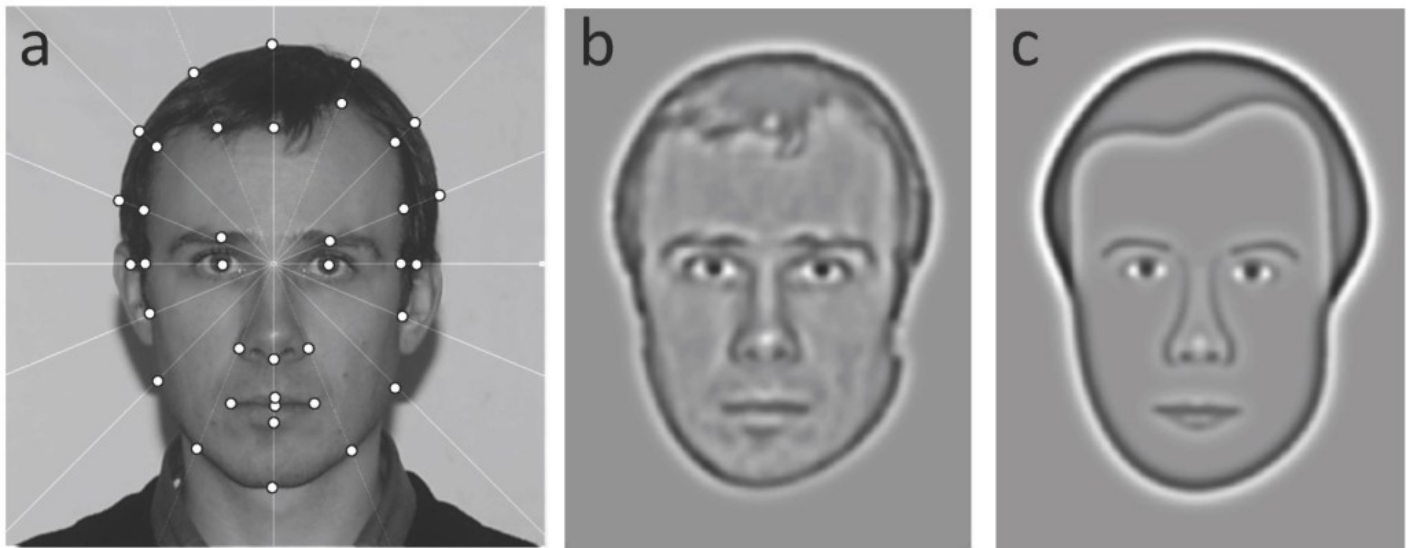


Fig. 1. Face images used in the new test. (a) A greyscale face photograph was superimposed with a grid centred on the bridge of the nose. The head-shape was measured at 16 locations (white dots). A further 9 locations were used to describe the subject's hairline. The location and shape of the internal face features (eyes, nose, mouth, eye brows) were also captured. (b) The greyscale face photograph filtered for the information which is most important for face identification. (c) An example of a face image used by the test.

For some people, however, discriminating between faces is not so easy. In fact, it has been estimated that as many as 3 in every 100 people have an impairment of face perception known as prosopagnosia (face blindness). People with prosopagnosia are at high risk of social embarrassment, social isolation, anxiety and depression. It is important for healthcare workers to be able to identify people with prosopagnosia: while treatments are not available, supportive strategies can be put in place to assist the sufferer.

A clinical face test needs to be fast to administer, reliable, repeatable and able to measure the whole range of face abilities (not just the most severely impaired). It must also measure what it sets

out to measure (and not allow subjects to use, say, clothing or hairstyles as clues) and be independent of other visual or cognitive problems (e.g. poor memory). Tests of face perception exist but most fall short in one or more of these requirements.

We have recently developed a new test of face discrimination that is quick to administer and is suitable for use by clinicians (including optometrists, GPs, psychologists and neurologists).

The Caledonian face test uses simplified face images (synthetic faces, synthesised from real face photographs (see figure 1)). Unlike photographs, synthetic faces can be very precisely modified. In the test, four faces are displayed on a computer; subjects click on the odd-one-out (see figure 2). In this way, the Caledonian face test measures the minimum difference required between faces for someone to be able to accurately tell them apart: the face discrimination threshold. Testing typically takes less than 4 minutes.

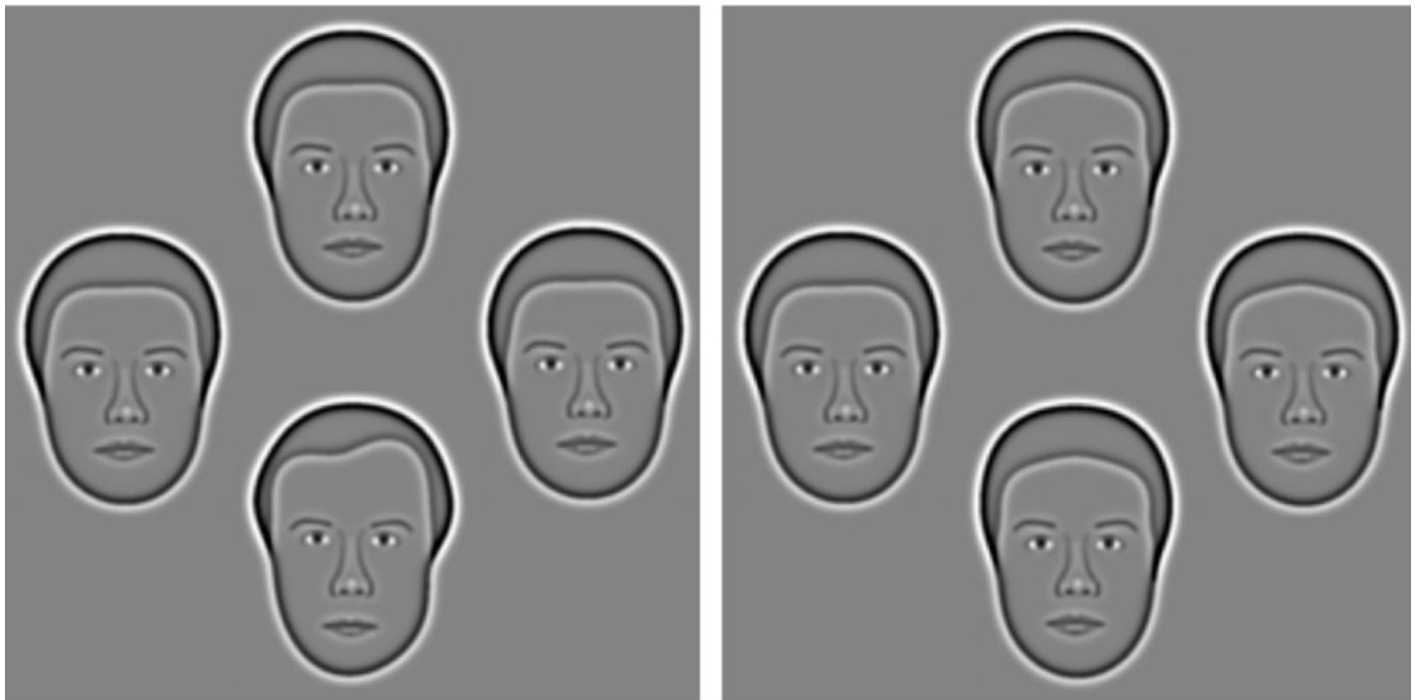


Fig. 2. The Caledonian face test. To avoid memory demands, participants are presented with 4 faces arranged in a diamond configuration and asked to indicate the 'odd' face that differs from the others. Left: easy example for most participants (approximately 95% of typical adults would recognise the odd face). The target (odd one) is at the bottom. Right: difficult example; 1 in 4 typical adults is expected to be able to spot the difference. One key advantage of using simplified faces is that they can be morphed to differ from any other by a specified amount. The task can be made as easy (Fig. 2 left) or hard (Fig. 2 right) as it needs to be to precisely quantify how sensitive people are and avoid floor and ceiling effects. The face test has been programmed to be completely adaptive: the difficulty of the test is adjusted in relation to the participant's performance by a highly efficient computer algorithm. If the participant is scoring particularly well, the test is

made more difficult by presenting faces that are challenging to discriminate between for an average person. If somebody struggles, the test will present images that appear obviously different to somebody with typical face sensitivity.

To establish the validity of our new test, we tested fifty-two young adults who had no known difficulties with face perception. We found a broad range of face discrimination thresholds: some participants were highly sensitive to small face differences; others required much larger differences for reliable discrimination. This suggests that face perception ability varies significantly in healthy young adults. When we re-tested participants, we found that the test was highly reliable and repeatable.

We also tested a patient (LM) who reported lifelong difficulties with face recognition and discrimination. LM's performance on the Caledonian face test was substantially outside the normal range (approximately 7 standard deviations). As a comparison, we also asked LM to undertake two widely-used tests of face recognition. On these tests, LM's scores were only just outside the normal range (2 standard deviations).

In conclusion, the results of this study suggest that the Caledonian face test offers a more sensitive method of detecting impairments of face discrimination than currently available alternatives. This raises the prospect that the new test has the potential to identify more subtle deficits of face perception which existing tests may miss. The Caledonian face test can be administered multiple times without participants becoming familiar with either the faces or the test order and hence the test may be used as a training tool as part of a rehabilitative strategy for patients with impairments of face perception.

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