Describe and evaluate research into face recognition

The ability to recognise faces is of paramount importance to humans, as it allows us to infer a diverse range of emotional responses essential for our very existence.

Face recognition is part of the broader process of facial perception. Theories of basic level pattern recognition, such as Biederman's geon theory, describe faces as a set of parts. Indeed, when asked to describe someone's face we have the tendency to describe it in terms of its features, the nose, the eyes and so forth. However, evidence suggests the visual system may not describe faces in this way. Bruce and Young, for example, support a more configural view of facial recognition. They suggest that we treat face patterns more as wholes or as inter-relationships between different features, than simply a list of features.

This idea of part-based description of facial recognition shaped much early research. Bradshaw & Wallace (1971) conducted experiments using identikit (a set of varying line-drawn faces) similar to those used by the police to construct a face based on a witnesses' descriptions. This early research concluded that faces are processed independently and in sequence.

However, some facial features, for example the chin, seemed to influence facial judgements more than others, which suggested evidence of interactive processing. Sergent (1984) reviewed Bradshaw and Wallace's study, and noted that faces which differed in several features also differed more in terms of overall configuration than those differing in only a few. If the features really are processed independently, the number of feature differences shouldn't affect how quickly a difference judgement is made. This evidence suggests that there's interactive processing of different dimensions of facial appearance: a configuration emerges from a set of features that's more than the sum of its parts.

Thus far, evidence has suggested that faces are processed holistically rather than as separate features, but does the orientation of a face affect how it is processed? Tanaka & Farah (1993) found that we are more likely to correctly identify facial features when they are presented in the normal upright context. However, this advantage wasn't found for inverted faces. They concluded that the representation of an upright face is based on a holistic description, while inverted faces are represented as a set of independent components. This account of facial representation was demonstrated by Thompson (1980) in the Thatcher illusion. This illusion involves cutting out the eyes and mouth of a photograph of the former prime minister and inverting them within the face. When viewed upright, the picture has a bizarre mis-shapen appearance, but when inverted, it looks quite similar to 'normal' versions. According to Bartlett & Searcy (1993), the most likely explanation of the Thatcher illusion is the configural-processing hypothesis, which claims that the relationship between the features is more difficult to perceive when the face is inverted.

Further information into the processes involved in facial recognition comes from the study of clinical cases, where individuals have lost the ability to recognise faces, even those familiar to them. The most common disorder of this kind is prosopagnosia. Some of these patients can derive particular kinds of meaning from faces (including emotional expression), despite being unable to recognise them. Conversely, some patients with a form of dementia can still classify famous faces according to their occupation, but are unable to recognise different emotional expressions (Kurcz & Feldemar, 1979). The task of recognising individual identity from a face therefore seems to be quite separate from that of recognising an emotional expression.

According to Bruce (1995), the complete identification of a known face requires not just that we recognise the pattern of the face as a familiar one, but that we know the context in which we've encountered the person and can retrieve his/her name. Studies of both normal and brain-damaged people suggest that there's a sequence of distinct stages involved in retrieving someone's identity, with failures at each stage characterised by different problems with identification.

Bruce and Young have attempted to create a model which outlines the processes involved in face recognition. In their model several different processing 'modules' are linked in sequence or in parallel, including face recognition units (FRUs) and person identity nodes (PINs).

Information about the faces of the people we encounter is processed by the FRUs. These contain stored representations of known faces. If the currently viewed face matches one of these representations, information about the resemblance is signalled to PINs. Basic information about personal identity is stored in the PINs, via which names and other details are accessed (from the additional information stores).

This model was revised by Bruce & Young (1986) to put the stages of personal identification into the broader context of their relationship with the other uses made of facial information. The model comprises several different processing 'modules' linked in sequence or in parallel.

Independent routes are drawn for the processing of emotional expressions, lip-reading (facial speech) and identification, thus allowing the processing of information from both familiar and unfamiliar faces. Directed visual processing allows for certain kinds of operation to be performed on faces without accessing their identities (such as looking out for white haired people when meeting your grandmother at the station). The route by which familiar faces are identified involves separate stages of representation of the face image (structural encoding), access of stored structural descriptions of known faces (face recognition units/FRUs), access of information about personal identify (via PINs), and finally, retrieval of proper names.

In support of this model, Groome *et al.* (1999) claim that the dissociation between processing of emotional expression and person identification makes good sense. Empirical support for Bruce and Young's model comes from the research into tip-of-the-tongue (TOT) phenomenon. In a TOT state, participants must be at the stage of PINs, but are unable to reach the next stage of name retrieval. Seeing the face shouldn't help, since there's no direct link between faces and names.

However, evidence from the study of prosopagnosic patients is difficult for the model to explain, as familiarity judgements are supposedly made on the basis of activation levels at FRUs, forming an early stage in the sequence of establishing the person's full identify. If patients consistently fail to make familiarity judgements at better than chance levels, they should be unable to access information from later (deeper) levels (stages) in the system. Yet this is exactly what covert recognition entails.

Partly as an attempt to overcome these difficulties, the model was revised and extended by Burton *et al.* (1990) and Bruce (1992).