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The Issue of Face Recognition

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Abstract: Recognizing the identities of people is a basic requirement for the establishment and maintenance of social act and communication and face recognition is an ability that humans develop and become very skilled as they grow up. Recognition has always been a very intriguing and highly researched topic and implies the tasks of identification or authentication. It is apparent that face recognition for human beings involves more than simple tasks of shape matching of features and face. Despite the fact that is not fully understood how humans recognise people what is known today is that they use a combination of identifiers such as height, voice and facial features.

Key words: Face recognition, comparison, memory factors, algorithms, human beings

INTRODUCTION

The human face holds key information about identity such as age, sex and ethnicity, information that enables the recognition of a single individual. Facial appearance provides universally interpretable information about a person's gender, ethnicity, age, intelligence, their emotional state and their health. Biologically, the facial phenotype is a product of genetics and environment that reflects features of populations in specific regions (Iscan and Loth, 2000; Fraser *et al*., 2003).

The face provides humans the sense of identity, being the most defining characteristic, by reflecting the age and by indicating sexuality and emotions. The faces represent who we are and act as the primary means for identifying people we know. The pattern of facial features of each human face is truly individual. Historically, man has sought to gain greater understanding of himself and others through study of the face and head (Taylor, 2000; Moreton and Morley, 2011).

FACE RECOGNITION

Recognition has always been a very intriguing and highly researched topic and implies the tasks of identification or authentication. Authentication involves a one to one comparison to verify a claimed identity. Identification often involves a one to many comparison to retrieve an initially unknown identity from a set of known possibilities. Face recognition is considered a natural and widely accepted identification and authentication method. It is known to play a crucial role in the establishment and maintenance of social communication (Smeets *et al*., 2010).

People easily recognise each other based on facial characteristics and do generally identify familiar faces with little effort despite possibly large variations of lighting, viewpoint and expressions and disguises such as beards, spectacles and hats. Moreover, familiarity with face permits identification even from very low quality images, however the ability to remember or even to match, unfamiliar faces is rather poor. The most obvious characteristic in the way we perceive a face is that of distinctiveness: unusual faces are better remembered than typical ones. Numerous studies have shown that faces rated as distinctive are subsequently recognized as familiar more quickly than those which are rated as more typical in appearance. Faces rated as typical are more likely to give rise to a false positive recognition. Distinctiveness also affects how quickly a known face is identified (Bruce and Young, 1998; Pascalis and Bachevalier, 1998; Hancock *et al*., 2000).

The human face consists of a 3D surface with an overlying reflectance function at each point on the surface. The three-dimensional information is determined by the structure of the human skull and by the shape and texture of the overlying skin and tissue. The reflectance function at any given point on the surface is simply a

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measure of how efficiently the skin at that point reflects light of various wavelengths. The information that reaches one's eye from this stimulus is therefore a complicated function of the three-dimensional structure of the facial surface, the reflectance function of the face at each point and the illumination and viewpoint conditions. Despite the complicated nature of the information in faces and the complexity of the tasks required to achieve some constancy in representing this information, human observers are remarkably good at recognizing and categorizing faces (O'Toole *et al*., 1999). There is evidence that the 3D shape of the face may be important in recognition as it appears that three-quarter views have an advantage in comparison with full face images in recognizing previously unfamiliar faces. However, it is actually remarkably difficult to recognize faces when only the 3D shape is given (Bruce and Young, 1998).

The failure to recognize a face can be due to a lack of compatibility between the images of the face used at encoding and at retrieval (memory factor), deterioration of image qualities (perceptual factor) or disruption of configural information as with inversions (object-related factor). The effects that arise from these different factors might be explained by some general principles found within these domains. The memory factor can be explained by the principle of encoding specificity which predicts performance from the degree of congruity between stimulus information presented at the time of encoding and retrieval; the perceptual factor can be explained by a minimal requirement of contrast for pattern vision and the object-related factor can be explained by a preferred (upright) orientation required for effective processing of configural or holistic information in faces (or other types of homogenous objects) (Liu and Chaudhuri, 2000).

DISCUSSION

There is evidence that face patterns are treated more as whole or as interrelationships between different features rather than simply as a list of their features. Experiments by Young *et al*. (1987) using the composite technique showed that we do not process facial features independently. In this experiment, faces were divided horizontally into upper and lower halves. The participants were accurate at recognizing the isolated top half of a face when it was seen on its own but when it was combined with the wrong lower half it was extremely difficult to recognize to whom the upper features belong. The pattern of face recognition appears to follow a holistic approach rather being based in a list of facial features (Young *et al*., 1987; Bruce and Young, 1998).

When unfamiliar faces must be recognized the external features such as hairstyle and head shape dominate the memory perhaps because these occupy large part of the image seen. As faces become familiar, there is a shift in memory so that internal face features become relatively more salient (Bruce and Young, 1998).

The orientation of a face has a profound effect on its recognition in humans with inverted faces being recognized with greater difficulty than upright faces. This inversion effect is exclusive to face processing since it is not observed when objects are used as stimuli and therefore has led to the view that face processing in humans depends upon a specialized neural mechanism. Both recording and brain imaging experiments in humans have revealed specific cortical areas in the ventral part of the occipitotemporal junction which are involved in face recognition (Pascalis and Bachevalier, 1998; Hancock *et al*., 2000). Converging evidence from four approaches (behavioural studies, neuropsychology, brain imaging and monkey single-unit recording) shows that cognitive and neural mechanisms engaged in face perception are distinct from those engaged in object perception including objects of expertise (McKone *et al*., 2007). Bruce and Young (1998) also suggest that the difficulty to recognize upside down faces seem to arise because we are relatively insensitive to the spatial relationships between the features of upside down faces and it is these spatial relationships that hold much of the information about personal identity.

There exists evidence in the literature that suggests that practice and experience might have an important influence on the ability to discriminate faces. One line of evidence is given by the other race effect for face recognition in humans, showing the difficulty that human subjects have in recognizing faces from a different ethnic group. Another line is provided by the study of face recognition in infancy. Research proposed that the development of face recognition processes in human infants occurs during ontogeny where cortical circuits develop their specialization for faces as a result of prolonged exposure to that class of stimuli. This proposal is strengthened by the findings indicating that the other-race effect is not seen in young children since they showed good recognition of both own race and other race faces. Because this effect appears only with adult participants, it presumably develops with greater experience or exposure during development with faces of one's own race than with faces of other races. The effect of practice and experience in face recognition processes fits particularly well with recent electrophysiological studies in monkeys indicating that face-selective cells are distributed over several temporal cortical areas that have different physiological properties and anatomical connections (Pascalis and Bachevalier, 1998).

Recently, extensive research has been taken place in the field of automatic face recognition using algorithms that appear to be more accurate than humans under optimal conditions at correctly identity matching or discriminating two different faces. Computer algorithms are capable of outperforming people on recognition of frontal face images when large and representative training dataset is available. However, machine based algorithms are still limited in the number of image variations they can generalize across. In facial images captured by different viewpoints and environmental conditions, the accuracy of computer facial recognition systems is worse than human performance. One of the most obvious differences between human and machine is the ability to learn. After a close look at a certain face, people can memorize and recognize that face in many unseen situations such as new pose, lighting and ages. In contrast with limited training examples, state of the art face recognition algorithms can only handle simple expression or occlusion changes, lacking the generalization to new complex situations (Peacock *et al*., 2004; Davis *et al*., 2010; Deng *et al*., 2010).

CONCLUSION

Facial features are not the only factors that can help in recognition. People can be recognized by their height, clothing, build, gait, posture and mannerisms but the face appear to be probably the most reliable route to person identification.

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