GUEST LEADER

What's in a face? Introducing the special section on Face Science.

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The faces of animals are central to their functioning in lived environments. For mammals, faces are usually the location of the sense organs, and thus provide the primary way of living in *umwelten*[1] (umwelt is the world as experienced by a particular organism). Mammalian faces are also an important location of non-verbal communication and expression, and convey a wide range of emotional and social information; for humans and many other primates, faces are also key for personal identity. The special significance of the face is likely the reason that the brains of primates have multiple face-selective cortical areas, the most well-known region in humans being the fusiform face area.[2]

For these, and many other reasons, faces are of considerable interest to scientists across a range of disciplines. Often the interest is at the level of basic scientific work, for instance describing the brain regions that are involved in the complex act of cognitively processing faces[3], or representing human faces with statistical models to compare populations of *Homo sapiens* across evolutionary time periods[4]. The interest in human faces is also driven by practical applications, such as automatic recognition of faces by computers[5], forensic portraiture of living or deceased people for identification[6], and rapid identification of potential illness or physical disorder in low-cost settings[7], among many others. Within policing and other law enforcement services, there exist several groups of practitioners who are especially involved in applied work that involves the human face; in the South African Police Service, at least three such clusters of applications exist: the Face Recognition Unit assists witnesses in creating composite portrait images of faces of suspects; a Face Reconstruction Group that reconstructs faces post-mortem to enable identification of deceased people; and then in standard detective work, police officers conduct identification parades in order to test and adduce evidence of identification in ongoing criminal investigations. A fourth application is matching photographs of faces to individuals, as performed by immigration officials at ports of entry into South Africa; although a different type of law enforcement agency, their work and abilities at matching photographs of faces in passports to faces of people physically co-present has long been important.

We noted the wide-ranging transdisciplinary interest in the human face some years ago during some research in collaboration with the South African Police Service[8], and instituted an annual Face Science Symposium (now in its eleventh year) to bring together researchers and practitioners from these diverse academic disciplines. This interdisciplinary symposium provides a platform for researchers and practitioners to present their work, to share their knowledge, and to engage in discussions and collaborations.

The special section on Face Science in this issue of the *South African Journal of Science* is a collection of articles that appeared in one form or another at one of these symposia. The articles present cutting-edge research and new perspectives on the study of faces within South Africa and provide insights into the promise of interdisciplinarity in the scientific study of faces.

In the first of the articles, Felix Atuhaire and Tinashe Mutsvangwa of the University of Cape Town, and Bernhard Egger of the Friedrich-Alexander-Universität, Erlangen-Nürnberg, describe research on using 3D face modelling to assess foetal alcohol syndrome (FAS). FAS is a condition caused by maternal alcohol consumption during pregnancy, and is especially prevalent in South Africa, where it has been estimated as being between 59.3 to 91.0 cases per 1000 people.[9] Facial dysmorphology of FAS is a key factor in early diagnosis. Current methods for automated analysis of the FAS facial phenotype use 3D facial image data from expensive surface scanning devices. The research reported by Atuhaire and colleagues used a 3D face model learned from a database of registered 3D face scans to reconstruct 3D face surfaces from single frontal 2D images. An important consideration driving their research was to find a solution that is low cost, and that can be used in resource-challenged contexts. The authors show the potential of the proposed framework to reliably estimate 3D landmark positions for components of the face associated with the FAS facial phenotype, using input images obtained from relatively low-resolution cameras. The study concludes by emphasising that future work should focus on improving accuracy and adapting the approach to predict face data of individuals with FAS. The article thus applies biomedical engineering and computer science skills to an important practical problem in southern Africa.

A second article, by Kyra Scott, Colin Tredoux and Alicia Nortje, all three associated with the University of Cape Town, applied computing methods to face images to generate synthetic faces from descriptions given by eyewitnesses, and to compare these to face composites made by witnesses with extant composite software. The reliability of facial identification evidence obtained from eyewitnesses, such as person descriptions and facial composites, is often questioned, and Scott and colleagues were interested in whether statistical models of faces could be used to produce better quality face composites than are presently possible (for a review of research on face composites, see the article by Vredeveldt and colleagues[10]). To test this hypothesis, a study with 167 participants compared the accuracy and precision of identifying a target face using person descriptions, facial composites, and computer-generated synthetic faces produced from person descriptions. The former two conditions used methods that are already used extensively in police forces around the world and were thus a useful basis for comparing the new idea of generating synthetic faces from descriptions. Results showed that person descriptions had higher accuracy but lower precision in narrowing down the suspect pool than the other two methods. The synthetic faces generated from descriptions did not fare any better than faces generated with extant composite systems. Their study highlighted the importance of person descriptions in accurately identifying unknown perpetrators, which although surprising – as a simple verbal description seems unlikely to capture more information about a human face than a complete visual representation – is consistent with earlier research. The study also introduces a distinction between concepts of identification precision and accuracy when assessing the utility of facial identification information.

Milton Gering, Tayla Johnson and Colin Tredoux, all from the University of Cape Town, considered the effects that stress has on face recognition in a simulated criminal context. The extant literature is unclear about this relation, and as Gering and colleagues point out, do not use experimental designs that honour the long-recognised[11] non-linear nature of the relation between arousal and performance. They present the results of two experiments examining the impact of stress on eyewitness performance in line-up face recognition tasks. In Experiment 1 they replicated previous studies in the area, finding a null result, while in Experiment 2 they found a non-linear relationship between stress and performance, with the stress group experiencing moderate levels of stress showing better recognition accuracy than low or high stress groups. These kinds of studies are difficult to conduct, given the obvious ethical constraints when inducing simulated stress, but Gering and colleagues found an ingenious way to induce different, and high levels of realistic stress in a naturalistic way. Their results support the proposition that the relationship between stress and face recognition is likely non-linear, and contend that the failure to find this, or even really address it in earlier studies, suggests the need for a different approach in future experiments on the topic.

The final article included in the special section is by Colin Tredoux, Ahmed Megreya, Alicia Nortje and Kate Kempen, and grew out of a collaboration between the University of Cape Town and Qatar University. Their study examines the own group bias (OGB) in face recognition, which is a tendency to better recognise faces of one's own group than another group; typically, 'group' is defined as a race or ethnicity, which is how it was defined in this study, but in other research has been extended to age and sex. The OGB has serious implications in criminal investigations and can lead to incorrect identifications, mistaken convictions, and imprisonment, which has happened several hundred times in the USA.[12] The experiment reported by Tredoux et al. aimed to determine whether the OGB occurs during encoding or retrieval of faces from memory. Participants, both black and white South Africans, encoded faces of both same and other races, and immediately tried to match the faces to members of photograph arrays. After a further delay, they tried to identify the faces from long-term memory. The results showed a crossover OGB in the delayed matching task, but an asymmetrical OGB at retrieval. Tredoux and colleagues then reasoned that in order to distinguish encoding from retrieval processes one should consider only stimuli successfully matched in the first phase of the experiment. Further investigation of recognition performance using these stimuli showed a non-significant OGB at retrieval but the authors concede that they may not have had enough statistical power to detect an OGB. Their study highlights the rapidly changing nature of the OGB across encoding and retrieval and uses a novel approach to distinguish effects at encoding and retrieval, but further work is needed to provide clear evidence of the origin of OGB.

Conclusion

We believe that the articles in this special section of the *South African Journal of Science* have demonstrated that there is active interest and research on the human face in a variety of disciplines in South Africa. Although we have showcased work here that is founded in the disciplines of Biomedical Engineering, Computer Science, and Psychology, there is much more work to be found in South Africa from disciplines such as Anatomy, Fine and Forensic Art, Physical and Social Anthropology, Policing, Semiotics, and Sociology. The special section also shows the promise of interdisciplinarity for better understanding of basic processes and for cogent applications of knowledge to practice. As the present articles all emerged in some form from the annual Face Science Symposium that we have organised since 2012, it is also evidence that explicitly interdisciplinary initiatives of such kind can bear fruit and bring interdisciplinary work into being.

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