Institution: University of Dundee

Unit of Assessment: 34: Art and Design: History, Practice and Theory

Title of case study:
Craniofacial Depiction for Forensic Identification and Archaeological Investigation

1. Summary of the impact (indicative maximum 100 words)

Wilkinson has developed, evaluated and applied techniques, standards and datasets for facial depiction and identification of the dead. The impacts include:

- Improved social welfare by establishing an international forensic tool that has enhanced forensic identification from human remains, and correspondingly improved law enforcement services and disaster victim identification.
- Delivered highly skilled people and international standards in forensic craniofacial identification.
- Provided cultural enrichment through enhanced public engagement with science and art internationally, through the craniofacial depiction of historical figures and ancient human remains.

2. Underpinning research (indicative maximum 500 words)

The underpinning research was carried out under the leadership of Prof Caroline Wilkinson from the Forensic Art Research Group established in Oct 2005 through collaboration between the Centre for Anatomy & Human Identification and Duncan of Jordanstone College of Art & Design, the University of Dundee, and followed on from her research at the University of Manchester.

Wilkinson up-dated and further developed a 3D computerized craniofacial depiction system utilizing existing 3D modelling software and haptic technology (SensAble Technologie's Phantom hardware and Freeform Modelling Plus software), a database of modelled anatomical structures and a 3D facial feature database collected from laser scans (3.1). In addition, standards were created from clinical images (CT, MRI, X-rays) and direct measurement of living subjects by her research team (2005-13) and applied and evaluated (3.2).

This system was tested in a number of blind studies using CT and laser scan data from living subjects from the USA (2010-2012), Korea (2009-11) and UK (2011-12), and evaluated in relation to the cross-race effect, reliability, reproducibility and accuracy (3.3,3.4). The degree of similarity between the subjects' face shape and the surface of the craniofacial depiction could be quantified using morphometric and face recognition software, and this directed further study into those areas of the face with highest error.

The relationships between the hard and soft tissues of the face were studied using cadavers, living subjects and donated ante-mortem and post-mortem data (3.2). In this way, standards enabling the determination of facial feature morphology from skeletal structure were developed and then tested for reliability, such as facial crease patterns (2010-2013), facial tissue depths (2012) and ears (2012). The use of craniofacial analysis in disaster victim identification was evaluated as part of the EU FP7 funded FASTID project (3.7), and new standards developed (2008-2013) for craniofacial superimposition, post-mortem depiction from partially decomposed remains and automated face recognition (3.8).

Wilkinson has employed the craniofacial computer system to analyse, authenticate and/or depict the faces of key historical figures, such as Richard III (Wilkinson REF 3), Mary Queen of Scots, Robert Burns, J.S. Bach (3.5), Rameses II, Arsinoe – the sister of Cleopatra, St Nicolas, and people from the past from skeletal remains, death masks and portraits. This work has directly influenced the current digital human research (3.9), especially in relation to the creation of 3D facial avatars and facial recognition.

The researchers involved in this team are Dr Chris Rynn (Lecturer), Caroline Erolin (Lecturer), Janice Aitken (Lecturer) and Dr Won-Joon Lee (Postdoctoral Researcher) at the University of

Dundee, and through collaborative links with many international forensic research groups, such as the FBI Academy (3.3), Interpol (3.7), Fraunhofer Institute (3.7), National Museum of Scotland (3.6), Catholic University of Korea (3.4), Ministry of Defense (3.9) and many archaeological research groups, such as the Bachhaus (3.5), Richard III Society (5.7) Theban Mapping Project in Egypt (3.6) and University of Leicester(5.7).

3. References to the research (indicative maximum of six references)

Outputs

3.1 Mahoney, G and Wilkinson, CM (2010) Computer generated facial depiction. Cpt 18 in Wilkinson, CM and Rynn, C. (Eds) *Craniofacial Identification*. Cambridge University Press (Wilkinson REF 2); 222-237; ISBN: 978 0 521 768627 hardback.

3.2 Wilkinson, CM (2010) Forensic facial reconstruction – anatomical art or artistic anatomy? *J. Anat. 216, 235–250*; Online ISSN: 1469-7580 (Wilkinson REF 4).

3.3 Wilkinson, CM, Rynn, C, Peters, H, Taister, M, Kau CH and Richmond, S. (2006) A blind assessment of computer-modelled forensic facial reconstruction using Computed Tomography data from live subjects. *Journal of Forensic Science, Medicine & Pathology 2 (3) 179-187*; ISSN: 1556-2891 (electronic version); Journal no. 12024 (Wilkinson RAE2008 2).

3.4 Lee, WJ, Wilkinson, CM and Hwang, HS (2011) An accuracy assessment of forensic computerised facial reconstruction employing cone beam computed tomography from live subjects. *J Forensic Sci* doi: 10.1111/j.1556-4029.2011.01971.x

3.5 *Bach through the Mirror of Medicine* – commissioned work in permanent exhibition at Bachhaus museum, Eisenach, Germany; opened 21 March 2008 http://b.cache.francais.bachhaus.de/files/0/7/1/71e0f1418fef2ab9e61f775348fed/01_Bach_Mirror_of_Medicine_EN2.pdf.

3.6 Wilkinson, CM (2008) The facial reconstruction of ancient Egyptians. Cpt 11 in David, R (Ed) *Egyptian Mummies and Modern Science*. Cambridge University Press; 162-180 ISBN: 978-0-521-86579-1 hardback.

Grants

3.7 Sue Black PI, Caroline Wilkinson CI: FASTID (Fast and efficient Identification) project in collaboration with Interpol, Fraunhofer Institute, Bunderskriminalamt, Crabbe Consulting and Plassdata - EU FP7: 2010 to 2013 – €2.3 Million.

3.8 Sue Black PI and Caroline Wilkinson CI: Prevention of the sexual exploitation of children – CAST and ISEC funding; 2011-14 - £250,000.

3.9 Chris Rowland PI and Caroline Wilkinson CI: Credible Avatars – MOD funding, 2012-14 - £380,000.

4. Details of the impact (indicative maximum 750 words)

Improved social welfare and cohesion

In international disasters, mass graves and scenes of crime facial recognition may be one of the only viable options for identification. However, misidentification from visual recognition is frequent and a reliable facial depiction system has improved the efficacy of investigations, which in turn has a positive effect on society with the efficient repatriation of victims and return of the deceased to the family and for judicial matters of estate. The use of these craniofacial techniques has been incorporated into Interpol's Disaster Victim Identification procedure (5.1) and has been confirmed as directly responsible for efficient identification by the police (5.2).

Delivering highly skilled people and international standards

Wilkinson's, 3D computerized craniofacial system is now utilised in international forensic institutes, such as the FBI Academy, National Centre for Missing and Exploited Children, Turkish Forensic

Institute, BostonPD and Royal Newfoundland Police (5.3), and this group has trained approximately 50 practitioners worldwide (South Korea, India, Malaysia, Japan, USA, Canada, Israel, Australia, Europe, South Africa, Turkey, Mexico and Romania) and has provided police training for Saudi Arabia, the UK and South Africa (5.4).

Wilkinson has acted as an expert witness in criminal courts in Britain and South Africa and is currently the only craniofacial anthropologist accredited by the Royal Anthropological Institute as a forensic practitioner. With the increase in social media and CCTV surveillance this is important to international security, law enforcement and social cohesion. She has had a direct effect on international policy through membership of US and UK Government sponsored Scientific Working Groups, e.g. Facial Identification (5.1) and Anthropology and the Association of Chief Police Officers Facial Identification Group (5.1). She has been involved in the drafting of numerous international codes of practice and practitioner guidelines through those groups and the British Association of Forensic Anthropology steering committee, the EU New Methodologies and Protocols of Forensic Identification by Craniofacial Superimposition (MEPROCS) research consortium (5.1) and the International Association of Craniofacial Identification Board of Governors.

[text removed for publication]. She is also frequently consulted by UK Police, Ireland's National Police, Netherlands Forensic Institute and Abu Dhabi General Directorate in relation to facial identification (5.2) [text removed for publication].

Cultural enrichment through improved public engagement with art, science and history

This research has enabled more reliable and realistic historical/archaeological interpretations of ancient remains and this has increased public engagement through museum exhibitions, publications and media events (5.5, 5.6, 5.7). The computerized facial depiction of people from the past became a recognized scientific method as a direct result of the BBC2 series *History Cold Case* (5.8) and Wilkinson featured as part of the Dundee team in each episode producing a digital craniofacial depiction, the reveal of which was the climax of each programme. Series 1 (2010) recorded over 2M viewers and led to a second UK series (2011).

The most significant historical projects of this group include the depictions of Mary, Queen of Scots (5.7), Richard III (5.7) and J.S. Bach (3.5). The former was central to an exhibition at the National Museum of Scotland (NMS) with >28,000 visitors, the second was integral to a C4 program with >4.1 million viewers and 64 million web discussions about the face, and the latter was placed in permanent exhibition at the Bachhaus with >7 million web page discussions. This work was directly responsible for a change in the way the public viewed these historical figures, away from the Shakespearean view of a twisted Richard III monster and towards the only portrait of Mary, Queen of Scots showing her during the period of time she lived in Scotland.

Wilkinson uniquely applied craniofacial analysis techniques to study the Lewis Chessmen (5.9) (discovered in 1831 on the Isle of Lewis) and this research was influential in changing the view of the production and likely use of these pieces.

Since 2008 Wilkinson's team have reconstructed approximately 25 archaeological faces and their work is exhibited in >ten new exhibitions around the world (5.7), including the National Museum of Ireland, Stirling Castle, Heritage Malta, Ulster Museum, Bachhaus (3.5), National Museum of Scotland, and the British Museum (Wilkinson REF 3).

In March 2013, the Centre for Anatomy & Human Identification applied for the 2013 Queen's Anniversary Prize for Higher Education (awarded 22 November 2013) (5.5) for their study and application of human anatomy, forensic human identification, disaster victim identification and forensic and medical art. This award recognised the Centre as being an international leader in craniofacial identification and forensic facial reconstruction for the identification of the living and the dead.

5. Sources to corroborate the impact (indicative maximum of 10 references)

5.1 International policy and professional guidelines:

- http://www.interpol.int/Public/FASTID/Default.asp
- http://www.meprocs.eu/metaspace/portal/11/346-about?pms=1,258,383002,view,normal,0
- http://www.fiswg.org/
- http://www.acpo.police.uk/documents/crime/2009/200911CRIFIG01.pdf

5.2 Forensic casework: (available on request).

- Letter of corroboration from UK Police
- Contact emails relating to UN, SOCA and international police forces

5.3 Forensic institutes using computerised system:

- Turkish Forensic Institute, Ankara: http://www.dailyrecord.co.uk/news/scottish-news/2011/08/12/turkish-police-turn-scots-university-for-help-in-tracing-missing-children-86908-23339716/
- BPD and NCMEC: http://www.dentsable.com/industries-facial-reconstruction.htm

5.4 List of National and International practitioner training (available on request).

5.5 Public Engagement:

- http://www.rse.org.uk/667_RSEPrizesforPublicEngagement.html
- http://www.royalanniversarytrust.org.uk/news/winners-announced-2013

5.6 Wilkinson and her team are frequently invited to speak at approx. 8 international public events per year, such as Elgin Museum, National Portrait Gallery, RCS Edinburgh, STEM, National Museum of Scotland, National Museum of Ireland, Musée du Quai Branly, Paris:

- http://www.southbankcentre.co.uk/sites/default/files/press_releases/SOUTHBANK_CENTRE_WIDE_OPEN_SCHOOL_RELEASE.pdf

5.7 Exhibited in museums around the world, including:

- Stirling Castle: http://www.telegraph.co.uk/science/science-news/7736059/Face-of-medieval-knight-reconstructed-by-computers.html
- Neolithic Maltese Woman http://heritagemalta.org/index.php/face-to-face-with-our-ancestors/
- Princess Takabuti: *http://news.bbc.co.uk/1/hi/northern_ireland/8311414.stm*
- Mary, Queen of Scots Exhibition at the National Museum of Scotland - Fri 28 June – Sun 17 November 2013: http://www.bbc.co.uk/news/uk-scotland-edinburgh-east-fife-23086520 ; http://www.theguardian.com/commentisfree/2013/jun/28/3d-model-mary-queen-scots-face
- Reconstructing Richard III – National Touring Exhibition of the facial reconstruction - 18 May 2013- 16 April 2014: http://www.leicester.gov.uk/your-council-services/lc/leicester-city-museums/exhibitions/richardiii/ (Wilkinson REF 3)

5.8 Wilkinson and her team have appeared in 16 television programs over the last 5 years for C4, BBC, STV, Discovery Channel, C5 and History Channel, including:

- History Cold Case: http://www.amazon.co.uk/History-Cold-Case-Complete-Series/dp/B004UR54SM
- Richard III – The King in the car park. C4 – 9pm 4 Feb, 2013 – 4.1M viewing figures: http://www.channel4.com/programmes/richard-iii-the-king-in-the-car-park/4od (Wilkinson REF 3)

5.9 News articles (available on request):

- http://news.bbc.co.uk/1/hi/scotland/highlands_and_islands/8352127.stm
- Daily Telegraph *Forensic scientists to re-examine Appin Murder* 11 Aug 2013.