Dolar, Mladen (2006). *A Voice and Nothing More*. Cambridge, Mass: MIT Press.

Downie, J. S. , Tcheng, David K., and Xiang, Xin (2008). *"Novel interface services for bioacoustic digital libraries"* in Proc. 8th ACM/IEEE-CS Joint Conf. on Digital Libraries. New York: ACM, 2008: 423-423.

Fuller, Matthew. (2005). *Media Ecologies: Materialist Energies in Art and Technoculture*. Cambridge, Mass: MIT Press.

Gitelman, Lisa. (2005) *Always Already New: Media, History, and the Data of Culture*. Cambridge, Mass: MIT Press.

Hirschkind, Charles. (2006) *The Ethical Soundscape: Cassette Sermons and Islamic Counterpublics*. New York: Columbia University Press.

High Performance Sound Technologies for Access and Scholarship project blogs.ischool.utexas.edu/hipstas/

Hughes, Thomas Parke. (1983) *Networks of Power: Electrification in Western Society, 1880-1930.* Baltimore: Johns Hopkins University Press. Print.

Josephson, Matthew (1992). *Edison: A Biography*. New York: J. Wiley. Print.

Kirschenbaum, Matthew (2008). *Mechanisms: New Media and the Forensic Imagination*. Cambridge, Mass: MIT Press.

LaBelle, Brandon (2010). *Acoustic Territories: Sound Culture and Everyday Life*. New York: Continuum.

Meintjes, Louise (2003. *Sound of Africa!: Making Music Zulu in a South African Studio*. Durham: Duke University Press.

Morton, David. (2004). *Sound Recording: The Life Story of a Technology*. Westport, CT: Greenwood Press. Print.

Moten, Fred (2003). *In the Break: The Aesthetics of the Black Radical Tradition*. Minneapolis: University of Minnesota Press.

Oard, D., M. Wu, K. Kraus, A. Hajj-Ahmad, H. Su, R. Garg (2014). *"It's about Time: Projecting Temporal Metadata for Historically Significant Recordings."* Forthcoming, Proceedings of the 2014 iConference. Berlin, Germany. 4-7 March 2014. ACM Digital Library. Web.

Ochoa, Ana Maíra (2006). *"Sonic Transculturation, Epistemologies of Purification and the Aural Public Sphere in Latin America."* Social Identities 12.6: 803-25.

Punyasena, Surangi W., Tcheng, David K., Wesseln, Cassandra, Mueller, Pietra G (2012). *"Classifying black and white spruce pollen using layered machine learning."*New Phytologist 196.3: 937-944.

Rodgers, Tara (2010).*Pink Noises: Women on Electronic Music and Sound*. Durham, NC: Duke University Press.

Smith, Mark M (2006). *How Race Is Made: Slavery, Segregation, and the Senses*. Chapel Hill: University of North Carolina Press. Print

Smith, Mark M (2001). *Listening to Nineteenth-Century America*. Chapel Hill: University of North Carolina Press. Print.

Sterne, Jonathan. *The Audible Past: Cultural Origins of Sound Reproduction*. Durham, NC: Duke University Press, 2003.

Sterne, Jonathan. (2011) *"Audio in Digital Humanities Authorship: A Roadmap."* (essay in progress) Super bon! Online: superbon.net/?p=1915 . Accessed June 7, 2013.

Sterne, Jonathan (2012). *MP3: The Meaning of a Format.* Durham: Duke University Press.

Su, H., Garg, R., Hajj-Ahmad, A., Min Wu (2013). *"ENF Analysis on Recaptured Audio Recordings."* Proceedings of the 2013 IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP). Vancouver, BC, Canada. 26-31 May 2013. 3018-3022. Web.

Thompson, Emily Ann (2002). *The Soundscape of Modernity: Architectural Acoustics and the Culture of Listening in America*, 1900-1933. Cambridge, Mass. : MIT Press.

Toop, David (2010). *Sinister Resonance: The Mediumship of the Listener*. New York: Continuum.

Weheliye, Alexander G. (2005). *Phonographies: Grooves in Sonic Afro-Modernity.* Durham, NC: Duke University Press.

For cultural histories of aurality, see entries for Smith 2001, 2006 in the bibliography; for sound reproduction, Sterne 2003, 2012; for the politics of the voice, Cavarero 2005, Dolar 2006; and noise, Attali 1984; for urban soundscapes, see entries for Toop 2010, Thompson 2002, Labelle 2010; ethnographic modernities and acoustemologies are covered in Hershkind 2006 and Ochoa 2006. The sonic construction of gender receives treatment in Rodgers 2010 and Martin 1991; for race and ethnicity, see Weheliye 2002, Moten 2003, Smith 2006, and Meintjes 2003.

New and recent developments in image analysis: theory and practice

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New and recent developments in image analysis: theory and practice

1. Introduction - David Robey, Oxford e-Research Centre

The historical concentration on text in humanities computing and the Digital Humanities (DH) partly reflects the technologies that have been available, and partly the majority interests of humanities researchers. Yet much humanities research also depends on scholars' visual skills, not only in the arts and archaeology, but also in disciplines whose main concern is text, for whom the physical form of texts can be as important as their content. Thus digital textual resources increasingly link to images, thereby greatly increasing their potential scholarly benefits: an outstanding example is Prue Shaw's recent digital edition of Dante's Divine Comedy. This panel session is concerned with what one might consider the next stage in the use of image in DH research: the technologies that are increasingly being used for image recognition, enhancement and analysis. Unlike many of the digital text-and-image archives now available, which do little more than accelerate and facilitate humanities research, these enable the production of knowledge that would simply not be accessible by non-digital means.

The panel presents a range of innovative humanities research in progress in these areas of image recognition, enhancement and analysis at Oxford University and UCL London. It includes both practical applications of the related technologies, and a more theoretical approach to the methods deployed. The latter is an area in which the humanities have traditionally been weak. Scholars have usually been reluctant to reflect in any depth on the exact nature of their methods; even during the heady days of humanities theory towards the end of the last century, the focus of interest was much more on high-level concepts, and much less on the details of methodology. Yet this kind of reflection is essential: if the most productive use is to be made of the new technologies for image analysis, and indeed all other forms of digital analysis in the humanities, and if we are to promote their use effectively, we need to be very clear exactly what they help us to do, and how this fits in with the work that scholars have traditionally done.

The panel will begin with a presentation by Charles Crowther, from the Centre for the Study of Ancient Documents at Oxford, of a range of techniques to increase the legibility of different forms of writing in the ancient world—ancient world studies being probably the field in which scholarship depends most on analysing the exact form in which text is preserved, and as a result the field in which the use these technologies is most advanced. This will be followed by an in-depth presentation and discussion by Jacob Dahl, of Oxford's Oriental Studies

Institute, of the use of one particular form of these technologies, Reflectance Transformation Imaging, to advance the study of one of the world's earliest and still undeciphered writing systems, proto-Elamite. The paper by Segolene Tarte, from the Oxford e-Research Centre, will provide the theoretical dimension by identifying the cognitive processes involved in some of research covered by the first two papers, and in other related work. Finally Julianne Nyhan, from the Department of Information Studies at UCL London, moves into a more difficult and experimental area with a review of the use of image recognition for historical research and a brief presentation of a project for the digital study of newspaper photographs in the context of the history of the First World War.

The work that the four papers deal with is highly detailed and specialist, but has potential applications far beyond the fields in which it has been carried out so far: a topic we plan to cover in the panel discussion.

* * *

2. Reading Ancient Writing: Technology and Scholarship - **Charles Crowther, Centre for the Study of Ancient Documents, Oxford**

Much of the evidence that the scholarly community in Classics has available to extend and renew its fields of investigation is fragmentary, difficult to decipher, and tantalising. The use of new technologies opens the prospect of making this evidence more easily and extensively accessible and exemplifies the contribution of DH to scholarly research in a well-defined and coherent context.

In this paper I review the effectiveness of a range of visualisation technologies deployed to increase the legibility of ancient, primarily Greek and Latin, incised and inscribed documentary texts, and consider some directions for future work. The analysis draws perspectives from work in this field at the Oxford Centre for the Study of Ancient Documents (CSAD) over the last 15 years, and presents results from recent and continuing projects undertaken with other presenters in the panel.

I consider two types of text that offer challenges to decipherment that are broadly similar but different in significant respects: wooden and metal writing tablets and inscriptions on stone.

Regular discoveries of incised wooden and metal writing tablets in excavation of Romano-British (and Northern European) sites potentially offer new categories of evidence, but their transcription and decipherment present the constant challenge of separating fine traces of writing from background features and, in many cases, from other palimpsest layers of text. The great majority of the material is relatively new (recovered since 1980) and is still in the early stages of integration into the body of research resources in Ancient History. Successive projects undertaken since 1998 at CSAD, in collaboration with colleagues in the field of medical image analysis in the Department of Engineering Science at Oxford, have resulted in the creation of new techniques for improving the visibility and legibility of writing on wooden tablets, principally by means of a stroke detection method (shadow stereo or phase congruency) and the removal of wood-grain (Brady et al. 2005).

These advances were based on digital scans of the writing tablets made with lights illuminating the surfaces from different angles, calibrated manually. Their application has already resulted in new editions of texts of writing tablets from the Roman fort at Vindolanda (Bowman and Tomlin 2005) and, most strikingly, a Roman legal document found in Frisia in 1914 (Bowman et al. 2009), which forms a case study in the paper offered by Dr. Tarte. Central to this programme of research has been the belief that in order to develop better imaging techniques we need at the same time to explore developments in the representation of semantics, in theories of reading, and in ideas about knowledge representation (Terras 2007; Tarte 2011).

Inscriptions on stone are one of the most characteristic legacies of the culture of the ancient Greco-Roman world, from the beginning of alphabetic writing in the 8th century BC to Late Antiquity. Very large quantities of inscriptions have been recorded – the total number now published exceeds 800,000 – but few have survived intact; stones are frequently broken into fragments and very many have suffered extensive surface damage from abrasion or erosion. Techniques for the decipherment of these damaged texts had not until recently advanced significantly since the beginning of epigraphic studies in the 15th century. The principal traditional means of reading letter traces, by taking paper (or latex) casts of the surface which can be manipulated more easily than the original stone, or by using solutions of charcoal and water to emphasise surface indentations, remain effective, but involve direct action upon the surface of the stone and are now permitted only under controlled conditions and in exceptional cases by museum conservators.

Because the language and formal character of inscribed documents are well understood, small improvements in reading can lead to significant advances in decipherment and interpretation. Two examples may be cited: much of the history of the 5th-century Athenian empire has seemed to turn on the interpretation of a handful of evanescent letter traces on a stele recording an alliance between Athens and Segesta (Chambers et al. 1990); a palimpsest inscription on a basalt stele recovered during the rescue exacavations at Zeugma in the Euphrates valley in 2000 has provided new insights into one of the more remarkable expressions of ruler cult in antiquity (Crowther 2013).

However techniques for recovering text, whether based upon paper casts, illumination with raking light, or, more recently, laser scanning can only improve legibility when there are some remaining topographic traces of the original inscribed text. In this section of the paper I summarise the results of experiments using the microfocus spectroscopy beamline at the Diamond Light Synchrotron in 2010 and 2011, following earlier work at the Cornell High-Energy Synchrotron Source (CHESS), which show that trace elements associated with wear of the inscribing tool and with the pigments used to paint inscribed letters can be detected with high sensitivity and spatial resolution by X-Ray Fluorescence (XRF) Imaging, even when the stone surface has worn below its original contours (Powers et al. 2005).

XRF imaging, for the moment, requires that text artefacts be brought to a synchrotron source and is ineffective where the surface of the object has been subject to intensive cleaning since Antiquity. In the great majority of cases, analysis of surviving surface traces continues to be the principal method of decipherment. Approaches to incised and inscribed texts, accordingly, converge on the need to recover and interpret surface topography as accurately as possible. The manually calibrated methods of illumination used in previous work at CSAD have now been replaced by Reflectance Transformation Imaging (RTI), whose application to cuneiform texts and seal impressions is described in the paper by Dr. Dahl.

RTI uses multiple images captured from a fixed camera position to construct a digital model of surface form and reflectance for the object studied. The resulting files enable interactive changes to lighting, image enhancements and automated identification of visual and morphological attributes. RTI has a number of specific advantages for the capture of incised and inscribed documents: non-contact acquisition of surface data, to alleviate the concerns of museum conservators; potential representation of 3D shape characteristics without data loss due to shadows and specular highlights; virtualised surface analysis under any form and distribution of lighting; the possibility of analysing surfaces remotely and ‘re-photographing’ them for dissemination. RTI representations of documentary texts are visually striking and attractive, but current fitting algorithms do not exploit the full potential of the image data captured. In the final section of the paper I report on current work undertaken at CSAD to improve the algorithms and capture processes and their application to a range of incised and inscribed documentary texts.

Selected References

A. K. Bowman, R. S. O. Tomlin, “Wooden Stilus Tablets from Roman Britain”, in Bowman and Brady 2005, 7-14

A. K. Bowman, M. Brady (eds.) Images and Artefacts of the Ancient World (British Academy Occasional Papers, Oxford 2005)

A. K. Bowman, R. S. O. Tomlin, K. A. Worp, “‘Emptio bovis Frisica’: the ‘Frisian ox sale’ reconsidered”, JRS 99, 2009, 156-70

M. Brady, X.-B. Pan, V. Schenk, M. Terras, P. Robertson, N. Molton, “Shadow Stereo, Image Filtering, and Constraint Propagation”, in Bowman and Brady 2005, 15-30

M. Chambers, R. Gallucci, P. Spanos, “Athens’ Alliance with Egesta in the Year of Antiphon”, ZPE 83, 1990, 38-63

C. Crowther, “Inscriptions on Stone”, in W. Aylward (ed.), Excavation at Zeugma. Conducted by Oxford Archaeology (Los Altos, 2013), 192-219

J. Powers, N. Dimitrova, R. Huang, D.-M. Smilgies, D. H. Bilderback, K. Clinton, and R. E. Thorne, “X-ray fluorescence recovers writing from ancient inscriptions”, Zeitschrift für Papyrologie und Epigraphik 152, 2005, 221-227

S. M. Tarte, “Papyrological Investigations: Transferring Perception and Interpretation into the Digital World”, Lit Linguist Computing 26(2), 2011, 233-247.

M. Terras, Image to Interpretation. An Intelligent System to Aid Historians in Reading the Vindolanda Texts (Oxford 2007)

Reflectance Transformation Imaging of ancient texts - Jacob Dahl Oriental Studies Institute, Oxford

This paper explores the use of Reflectance Transformation Imaging (RTI) technology in the study and decipherment of ancient texts. RTI is “a computational photographic method that captures a subject’s surface shape and color and enables the interactive re-lighting of the subject from any direction” (definition from http://culturalheritageimaging.org/Technologies/RTI/). It is based on the work of Tom Malzbender (2001, see http://www.hpl.hp.com/research/ptm/index.html).

The camera dome used at the University of Oxford, and built by researchers at the University of Southampton (Earl et al. 2011), uses 76 daylight-LEDs, which are attached to the inside of the plexiglas dome. A high-resolution digital camera is mounted on the top of the dome, looking straight down through a hole. The object is placed on a stage in the centre lifted up to the horizon. The diameter of the camera dome is approximately 1m, allowing for the capture of objects up to 33 cm in diameter. 76 individual raw files are captured each using a different light source and therefore a different light angle. In post-processing the images are joined to create a composite image (model) (Polynomial Texture Mapping (PTM)) where the light-source can be changed by the user.

Using RTI images captured in the Louvre Museum in Paris, researchers at the university of Oxford have been able to significantly advance the study of one of the world's earliest and still undeciphered writing systems, proto-Elamite, mimicking in the classroom the work of the epigrapher in the museum. This method has proven particularly valuable when examining secondary additions to certain signs, lightly impressed signs, alterations to signs, or seal impressions.

Proto-Elamite is the conventional name give to a derived writing system emerging in Iran following the spread of the culture and technological advances of the Late Uruk period in Mesopotamia into Western Iran c. 3500 BC (Dahl 2013a). The writing system is defined by having a high number of singletons, and possibly a high number of scribal errors, perhaps resulting from never having been standardized (Dahl 2002 and Dahl 2013b). A majority of the extant proto-Elamite texts are kept in the Louvre Museum, Paris, and the National Museum of Iran, Teheran. The writing system disappeared after a short use of at most a few centuries, and writing was not used in Iran for the following five centuries or longer.

It has long been realized that deciphering early scripts involves more than merely a linguistic puzzle, that features such as seal impressions, scribal marks, etc. hold valuable information, and that the materiality of writing is therefore more important for the study of early writing then anywhere else (Damerow 2006). Subtle differences in sign forms may be the result of scribal hands, semantic variation, or simply lack of practice (André-Salvini and Dahl in press).

Traditional print-representations of early writing specimens only poorly represent the physicality of the object. Proto-Elamite and other early writing systems are often studied by very small groups of researchers at universities or research institutions across the globe. Previous generations of researchers were confined to either using hand copies of the originals, of varying quality, or consulting the originals in museums far from their home institutions, when attempting to decode the information of these documents. High-resolution, dynamic images of these text artifacts therefore have the potential of transforming the study of early writing by simulating first-hand consultation of the originals, enabling shared research, and bringing together disparate data-sets.

Over the course of the last two years c. 1100 tablets and fragments in the Louvre Museum were imaged with the camera dome (André-Salvini and Dahl 2013a). Results of research facilitated by these images is now being published. For example, the study of RTI images of two tablets in the Louvre Museum (Sb 15229 and 15456) challenged the existing view of the imagery of the seal impression found on both (a couple of humanoid figures as well as animals), and led to a strengthening of the theory that no representations of the human form was allowed in glyptic art of the proto-Elamite period (results later confirmed by collation of originals in the Museum) (Dahl 2014).

The main issue facing a wider application of RTI technology in the study of ancient writing is the size of the files (mostly 256 mb per image, six needed for a cuneiform tablet), and the lack of a suitable on-line viewer. Image size is becoming less of an issue over time, and the issue of an on-line viewer is the focus of at least one ongoing project (http://www.arts.kuleuven.be/info/ONO/Meso/cuneiformcollection and http://portablelightdome.wordpress.com). In the meantime captures taken by the camera dome can be used to produce very high quality static images by blending different views together in an image editor.

Selected References

André-Salvini and Dahl 2013: “L’écriture proto-élamite: la numérisation à l’aide du déchifrement des premières écritures”. In Grande gallerie: le journal du Louvre 2013/2, 28-29.

André-Salvini and Dahl in press: “Le système d’écriture proto-élamite : un point sur le déchiffrement des signes, leur formation et leur usage”. In La recherche au muse du Louvre 2012 (2013).

Dahl 2002: “Proto-Elamite Sign Frequencies.” In CDLB 2002:1 (2002) http://cdli.ucla.edu/pubs/cdlb/2002/cdlb2002_001.html

Dahl 2013a: “Early Writing in Iran”. In Potts, D.T., Oxford Handbook of Iranian Archaeology (Oxford University Press) (2013), 233-262.

Dahl 2013b: “Frühe Schrift im Iran”. In N. Crüsemann et al. Uruk 5000 Jahre Megacity: Begleitband zur Ausstellung "Uruk--5000 Jahre Megacity" im Pergamonmuseum--Staatliche Museen zu Berlin (2013), 202-203.

Dahl 2014: “The proto-Elamite seal MDP 16 no 198”. In CDLN 2014:1 <http://cdli.ucla.edu/Pubs/cdln/archives/000028.html>.

Damerow 2006: “The Origins of Writing as a Problem of Historical Epistemology.” In CDLJ 2006:1 (2006) <http://cdli.ucla.edu/pubs/cdlj/2006/cdlj2006_001.html>

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Digital Images of Ancient Textual Artefacts. Connecting Computational Processing and Cognitive Processes - Ségolène Tarte, Oxford e-Research Centre

Digital image processing is an expanding domain in the DH that naturally finds its place in the overall

knowledge and meaning creation process that is the ultimate aim of the study of ancient textual artefacts. The cognitive aspects of this intrinsically interpretative process play a major role in the endeavour and continually interact with the computational processing mobilized by image capture and processing methodologies. In this paper, I aim to present some of the cognitive aspects of the interpretation of textual artefacts that intervene in the analysis of their digital image avatars. To illustrate those cognitive processes, I will present them in the context of "naturalistic" observations of expert papyrologists and assyriologists working on ancient textual artefacts (observations made following ethnographic methodologies) , and connect them with similar observations made in the controlled settings of laboratory experiments as reported in the cognitive sciences literature. Each example illustrates how one specific cognitive process has been aided by the use of digital image-based technology, and how they are integrated into the interpretation workflow.

It is worth specifying that the processes highlighted here are perceptual in nature, rather than conceptual; however, as they participate in the act of interpretation of textual artefacts, in the act of knowledge creation and sense-making, they definitely qualify as cognitive processes. These cognitive processes are efficient and complementary with the services that digital tools can render. My aim in identifying them is not to attempt to emulate them digitally, but rather to identify where computational processing can provide help and where the upper hand is best left to the experts.

Making the intangible tangible: Artemidorus papyrus (in collaboration with Prof. D'Alessio (KCL), and Dr Elsner (Oxford))**.** Here the computational processing involved infrared image capture, and, in later work, digital image alignment (of the front and back images) as well as virtual rolling of the papyrus (Tarte, 2012). The virtual rolling was made in order to evaluate the hypothesis that the papyrus fragments needed to be reordered based on traces of inks from the reverse of the papyrus that seemed to have transferred to the obverse by mirror impression while the papyrus was rolled up. Beyond providing a rigorous argument in favour of reordering, the actual process of virtually rolling the papyrus prompted a re-materialization of it. A physical avatar was produced which allowed the researchers to experience for themselves the rolling of the document and thereby ascertain that the ink transfers could have resulted from the roll, confirming the plausibility of the reordering of the fragments. This enacted approach to interpretation, enabled by the upstream image-based technologies that have been mobilized, points to what the neurosciences call **embodied cognition**, where "Social Meaning is primarily the object of practical concern and not of theoretical judgment… It relies on non-inferential mechanisms, which do not require the explicit use of rationality" (Gallese, 2005, p43). Through a combination of image processing output and enacted engagement with a physical avatar, aspects of the intangible papyrus have been made tangible.

Making the inarticulate articulate: the Roman stylus wooden tablet known as the "Frisian Ox" tablet (in collaboration with Prof. Bowman (Oxford) and Prof. Terras (UCL)). Beyond image capture, here the computational processing involved removing the woodgrain and enhancing the visibility of the scratches that constitute the script (Tarte, 2011). Digital technologies were also used to produce line drawings by means of a drawing tablet that allowed for the tracing of the text over any digital image from the collection that had been captured. One of the cognitive processes that ensued has to do with **visual completion**. By tracing the letter shapes, experts filled in the gaps where portions of character were absent. This enacted approach to interpretation, enabled by the upstream image-based technologies that have been mobilized, points to the phenomenon the neurosciences call **illusory contour**: "Detection of an illusory figure shows a precedence of specific global object properties over local attributes ... it is the surface rather than the contour that guides search" (Conci et al., 2007, p1293-4). This in part explains why the expert papyrologists stipulated that the woodgrain removal algorithms applied to the images were not only not very helpful, but also possibly confusing. Through a combination of illusory contour detection and digital tracing of the letters, aspects of the inarticulate text of the tablet have been made articulate.

Making the invisible visible: proto-Elamite tablets from ancient Iran (in collaboration with Dr Dahl (Oxford) – cf paper on this panel). Here the computational processing involved the deployment of an advanced image capture technique known as Reflectance Transformation Imaging (RTI (Earl et al., 2011)). Through this technique, it is possible to interactively change the position of a unidirectional light source shone onto the artefact, thereby allowing for the accentuation of its physical geography - an enormous asset when dealing with 3D scripts such as proto-Elamite. In effect, what RTI allows is to mobilize **depth perception through monocular motion parallax** (Rogers and Graham, 1982): RTI supports depth perception, and results in making visible the otherwise invisible.

Making the indiscernible discernible: Selenite curse tablets from Ancient Cyprus (in collaboration with Dr Bodard (KCL) and Prof. Radaelli (Oxford)). Here the crystalline nature of the support makes the texts indiscernible. As mounting evidence in recent bodies of work in the cognitive sciences points to an **action-simulation-perception framework** (related to embodied cognition), where visualizing the results of an action mobilizes the pre-motor areas of the brain that correspond to the observed action (such as in reading/ writing, or in painting (Taylor et al., 2012)), Scanning Electron Microscope (SEM) images, which reveal disruptions in the crystalline structure of selenite, have the potential to inform the viewer on the ductus and the dynamics of the act of writing, thereby facilitating reading by making the indiscernible dynamics of writing discernible.

In each of these examples I have selected one specific cognitive process that took place. Of course, many others occurred, and each of those cases could have been used to illustrate one or more of the other cognitive processes highlighted here. Further work will explore the interaction of the perceptual and conceptual cognitive processes mobilized in the interpretation of textual artefacts, and how to integrate them in a digitally supported workflow.

Selected References

Conci, M., Müller, H. J., and Elliott, M. A. (2007). *The contrasting impact of global and local object attributes on kanizsa figure detection*. Perception & Psychophysics, 69(8):1278—1294.

D'Alessio, G. (2009). *On the "Artemidorus" Papyrus*. Zeitschrift für Papyrologie und Epigraphik, 171:27—43.

Earl, G., Basford, P. J., Bischoff, A. S., Bowman, A., Crowther, C., Hodgson, M., Martinez, K., Isaksen, L., Pagi, H., Piquette, K. E., and Kotoula, E. (2011). *Reflectance transformation imaging systems for ancient documentary artefacts*. In Electronic Visualisation and the Arts, London, UK. BCS, The Chartered Institute for IT.

Gallese, V. (2005). *Embodied simulation: From neurons to phenomenal experience.* Phenomenology and the Cognitive Sciences, 4:23—48. 10.1007/s11097-005-4737-z.

Rogers, B. and Graham, M. (1982). *Similarities between motion parallax and stereopsis in human depth perception.* Vision Research, 22(2):261 — 270.

Tarte, S. M. (2011). *Papyrological Investigations: Transferring Perception and Interpretation into the Digital World*. Lit Linguist Computing, 26(2):233—47.

Tarte, S. M. (2012). *The digital existence of words and pictures: The case of the Artemidorus papyrus*. Historia, 61(3):325—336 (+bibliog. pp 357—61; fig. pp 363—5).

Taylor, J. E. T., Witt, J. K., and Grimaldi, P. J. (2012). *Uncovering the connection between artist and audience: Viewing painted brushstrokes evokes corresponding action representations in the observer*. Cognition, 125(1):26 — 36.

Facial recognition and Digital Humanities: new directions? - Julianne Nyhan, Department of Information Studies, UCL

As documentary sources photographs can offer historians new ways to uncover, interrogate, visualise and communicate about the past. In the past new insights into historical questions have been gained through unexpected and often serendipitous observations in historical photographs: for example, the seemingly accidental discovery of the young Hitler in photographs of social-democratic rallies (cf Krumeich 2001). Recent developments in facial recognition and image analysis techniques (see, inter alia, Wang et al. 2013, Singh et al. 2013 and Vieira et al. 2013) offer historians (and researchers across the humanities and beyond) new ways to think about and analyse visual documentary evidence. The application of facial recognition techniques may well contribute to the establishment of a more systematic basis for the discovery and analysis of actors and social networks in historical photographs, and perhaps for automatically identifying 'suspect' photographs. Nevertheless, comparatively little research seems to be ongoing within the DH into the applications of such facial detection, recognition and visual computing techniques.

Automated facial detection has become ubiquitous in day to day life. It is used on public and private CCTV-networks for crime and terror prevention, for example, by preselecting information for screening and at border controls using biometric passports. Digital cameras and mobile phones can auto-detect faces and even smiles on faces (see Deniz, O. et al. 2008), replacing traditional passwords or providing 'convisual' information to photographers, like the names of the people in the viewfinder if these people have been photographed before (see, for example, Brown 2011). Social media networks like Facebook or Twitter engage in the batch-tagging of people in photographs, while popular image cataloguing software packages like Google's Picasa allow automatic graphical indexation of large snapshot collections at home. Automated facial detection, despite still being a relatively new branch of image analysis, has quickly matured and allows the facial indexation of large graphical databases. The result is that graphical information can be searched in ways that have hitherto been impossible.

Nevertheless, within the context of DH, few applications of such techniques can be noticed in the published literature. The paper will start with a review of literature related to image analysis techniques in order to present both the technological state of the art and uses that are being made of image analysis techniques in DH. A review of the literature relating to historians' methodological engagement with visual documentary sources will also identify existing and new research problems in historical research that facial recognition techniques could be applied to, leading to a discussion of the potentials and drawbacks that facial recognition techniques hold for this kind of research.

In the context of DH, the most substantial research to date is that of Suárez, de la Rosa Pérez and Ulloa (2013), who have applied such techniques to representations of the human face in world literature. To do so they analysed more than 123,500 paintings from all periods of art history with a face recognition algorithm used in Facebook's photo-tagging system and automatically identified over 26,000 faces. Using techniques like, among others, the Elastic Bunch Graph Matching (Wiskott et al. 1997), they were able to detect what they term basic features (e.g. information about the position of facial features such as eyes and nose) and extended features (e.g. gender, mood, age range). They conclude that by comparing "the basic features set using graphs and the extended features set using clustering by K-Means method (Sculley 2010) … we are at the perfect position to analyze and characterize each of the groups according to different historical perspectives and cultural questions, for instance, the distinction among styles by giving a minimum set of features that determines its membership" (p, 535) .

From the perspective of facial recognition techniques noteworthy recent developments include the 3D face recognition systems by the University of Bradford's Centre for Visual Computing, which they state has led to the development of a prototype system that "demonstrates that 3D facial data can overcome many inherent problems in image-based (2D) face recognition. This can be accurate up to the level of differentiating between identical twins" (see University of Bradford 2013). However, for my present purpose it is mostly historical photographs that are under discussion and at the time of writing it is not clear how such a system would work with historical photographs (even if 3D models of the 2D photographs were created using technology such as freely available software platforms like 123D Catch).

To conclude the talk an overview of the initial findings of a project on First World War photographs that we have recently started will be presented. WW1 was the first major war where photography was affordable and routinely used in both official and amateur channels; thus visual documentary evidence from the period is vital to its study. During WW1 Belgian refugees arrived in Britain en masse in what transpired to be the largest ingress of refugees in British history. However, our understanding of who arrived, how they intersected with British and diasporic social networks, how long they stayed, and whether they settled or returned home is limited. One of the historical applications reported on in this paper will be the initial findings of a pilot project that is investigating accuracy rates of facial detection techniques on historical photographs of WW1 Belgian refugees.

References

Brown, Mark. 2011. *"Facebook Silently Rolls Out Face Recognition Tagging to the World."*Wired, 08 June 2011 edition, sec. Technology. http://www.wired.co.uk/news/archive/2011-06/08/facebook-face-recognition.

Deniz, O., Castrillon, M, Lorenzo, J, Anton, L, and G. Bueno. (2008) *'Smile Detection for User Interfaces',*Advances in Visual Computing, vol. 5359/2008, pp. 602–611

Krumeich, Gerd. "Hitler in der Menge," in: C. Dipper, A. Gestrich, L.Raphael (eds.), *Krieg, Frieden und Demokratie: Festschrift für Martin Vogt zum 65. Geburtstag* (Frankfurt, 2001), 137-140.

Singh, Chandan, Ekta Walia, and Neerja Mittal. 2012. *"Robust Two-stage Face Recognition Approach Using Global and Local Features."*The Visual Computer 28 (11) (November 1): 1085–1098. doi:10.1007/s00371-011-0659-7.

Suárez, de la Rosa Pérez and Ulloa (2013) *'Not Exactly Prima Facie: Understanding the Representation of the Human Through the Analysis of Faces in World Painting'* DH Book of Abstracts. 534-6. Nebraska: Centre for Research in the Humanities

University of Bradford, ***'3D Face Recognition For Security Systems '*** www.visual-computing.brad.ac.uk/case-studies/3d-face-recognition-security-systems (accessed 31/10/2013)

Vieira, Tiago F., Andrea Bottino, Aldo Laurentini, and Matteo De Simone. 2013. *"Detecting Siblings in Image Pairs."*The Visual Computer: 1–13. doi:10.1007/s00371-013-0884-3.

Wang, Zhifei, Zhenjiang Miao, Q. M. Jonathan Wu, Yanli Wan, and Zhen Tang. 2013. *"Low-resolution Face Recognition: a Review."*The Visual Computer: 1–28. doi:10.1007/s00371-013-0861-x.

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