

Digital visualization as a scholarly activity

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Abstract

Thought processes are enhanced when ways are found to link external perception with internal mental processes by the use of graphic aids. Such aids range from scribbled diagrams to sophisticated linkages between thought, images, and text such as those employed by Leonardo da Vinci. These tools allow visual perception to be harnessed in the dynamic processes associated with the creation or discovery of new knowledge. Digital humanists are applying digital versions of these age-old tools in many areas of research, from the graphs generated by text analysis applications to virtual reality models of ancient buildings, methods known collectively as 'digital visualization'. This article begins with a brief review of the current application of visualization in the digital humanities before moving on to establish a context for digital visualization within 'traditional' humanities scholarship. This provides a context for an examination of what is required in order to ensure that digital visualization work is performed with identifiable intellectual rigour. The London Charter is used as a case study for a possible framework for the development of appropriate methods and standards. Digital visualization as a scholarly methodology is discussed and demonstrated as being part of a continuum of established academic practice rather than something that is in some way new, 'revolutionary', or lacking in rigorous scholarly value.

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1 Introduction

The numerous visual metaphors that are used to describe our cognitive processes hint at the nexus of relationships between what we see and what we think. We say we 'see' when we mean that we 'understand'; we try to organize and make our ideas 'clear' by bringing them into 'focus', and so on. When faced with tasks that require substantial thought or organization of ideas we will often reach for a pen and paper to 'sketch out' (another visual metaphor) our thoughts. There exists an instinctive deep understanding that one can enhance one's thought processes by finding ways of linking external perception with internal mental processes.

Graphic aids to thinking are not new, but the emergence of digital technology has created a new medium for these tools that provides extended functionality and many new opportunities for development. This in turn offers the potential for new research methodologies that amplify cognition. These serve two distinct purposes, one of which is sometimes described by the use of the hackneyed phrase 'A picture is worth ten thousand words'.¹ However, this misses the true purpose of visualization as what is being described by that phrase is simply a matter of transmission, i.e. of having high bandwidth to transmit large volumes of information. Arguably such transmission is not even 'communication' as it is unidirectional, a monologue rather

than a conversation. Of far greater importance is the ability of these tools to allow visual perception to be used in the creation or discovery of new knowledge. However, knowledge is not transferred, revealed, or perceived, but is created through a dynamic process. This raises epistemological issues concerning visualization and points the way to an intellectual approach to the subject.

It is necessary at the outset to define what it is that is meant by 'scholarly activity'. Many of the definitions are surprisingly circular; scholarly activity being something which is done by scholars who are in turn defined by being those who conduct scholarly activity. It is known instinctively that scholarly activity is about the discovery, exchange, interpretation, and presentation of knowledge but what is it precisely? While one may not always commend Wikipedia to students it does, in this case, provide a useful set of simple statements describing scholarly method: 'the body of principles and practices used by scholars to make their claims about the world as valid and trustworthy as possible, and to make them known to the scholarly public'.² There are two aspects to this: one governs the conduct of research, the other the dissemination of the details and outcomes of that research to other scholars, and maybe the public at large. The Wikipedia entry continues, 'This article focuses on scholarship in the narrower sense, covering rational inquiry in areas that are mostly too complex to yet be treated by science. These include history as well as the creations of the human mind in the form of art, music, literature, religion, philosophy, and cultural beliefs'.³ This refers to disciplines that are at the heart of humanities research and helps us draw a distinction between 'scientific visualization' and 'humanistic visualization'. The digital humanities are taking what is perceived by the public to be the tool of the scientist and using it to conduct 'rational enquiry in areas that are mostly too complex to yet be treated by science'.⁴ Ultimately the approaches used in humanities computing will therefore, in the main, be substantially different from those used in the sciences and one could justifiably describe them as belonging to a field of 'Humanistic Visualization'. While this prospect is very gratifying for those of us working in the area

a further question will inevitably be raised by our peers, of whether what we are doing is simply developing a 'method'⁵ or contributing to a 'methodology'?⁶ The difference is perhaps of being regarded either as 'technicians' or 'scholars'.

What is 'visualization'? Some would define it as a group of techniques (methods) for creating images, diagrams, or animations to communicate a message. This form of visualization has utilized visual imagery as an effective way to communicate both abstract and concrete ideas throughout human history. Examples include cave paintings, Egyptian hieroglyphs, ancient Greek geometry, and the technical drawings of Leonardo da Vinci. The use of images for communication during the larger part of our history is reflected in images produced by hand or those reproduced in print media. This historical perspective raises three important questions, each of which has a bearing upon an examination of digital visualization as a scholarly activity:

- What role have visualizations played in humanities scholarship in the past?
- If the majority of images in print are to be regarded as 'illustrations' what is the distinction between 'visualization' and 'illustration'?
- How has the emergence of digital media affected the development of visualization?

First, the definition of 'visualization' can be completed by examining the second question; 'how does visualization differ from the forms of graphical representation that have been used to produce illustrations throughout history?' For example, few would regard the devotional art of the late Middle Ages as mere illustration. St Augustine and St Thomas Aquinas argued that physical images could be used by worshippers to envision the divine through prayer. These were not just illustrations of religious figures and events, they were images that were intended to assist thought and, depending on your personal beliefs, higher mental and metaphysical processes. Jean Gerson, a theologian and Chancellor of the University of Paris in the early fifteenth century wrote about learning to transcend with our minds from visible things to the invisible, from the corporeal to the spiritual. He saw this as the purpose of the image (Donovan, 2007).

Although the distinction between illustration and visualization is a topic rich with possibilities for discussion, I must skirt around this question as this article concerns *digital* visualization and I believe it is in the 'digital' that digital visualization can go beyond mere method to become methodology.

A digital visualization differs from a printed illustration in two related characteristics:

- It is interactive.
- It allows manipulation of both the graphical representation and the data it is derived from.

However, these criteria apply to virtually all graphics produced by computers; a scatter graph plotted using a spreadsheet can be part of an interactive and iterative process of exploration as the user refines the display, selecting different subsets of the data to display, changing scales or line fitting algorithms, or performing statistical operations upon the data. In many respects, it is therefore correct to describe a spreadsheet as a visualization application, at least in the style of its usage, as it is effectively applying a visualization interface to a method of exploratory data analysis. Clearly this is not an adequate description of digital visualization.

A visualization departs from being an illustration when it becomes the principal medium of communication. The term 'Illustration' implies an image which serves only to support written language; thus the main carrier of information is the associated text not the image. Many consider that an image can only be a true visualization when it is the primary carrier of information, not a supplement to a piece of text. I shall settle on a distinction in which an illustration is intended merely to *support* a rhetorical device (usually textual) whereas a visualization is intended either to *be* the primary rhetorical device or serve as an alternative but parallel (rather than subordinate) rhetorical device. This indicates where attention needs to be focused in order to determine what is required to ensure that digital visualization is seen to have the intellectual rigour expected of a scholarly activity.

There is a broader issue which concerns the emphasis that humanities scholars place on written language and their apparent mistrust of images.

This arguably has a justifiable basis in historical fact; William Ivins has written about the limitations of images in scholarship from ancient times to the relatively recent past of our print culture that were due to the difficulties of producing what he calls 'exactly repeatable images' (Ivins, 1969). He argues that it has been impossible to use images to disseminate ideas because of the problems of reproducing them accurately. This mistrust also has a philosophical underpinning by philosophers from Plato to Descartes (and beyond). Space does not permit this past history to be discussed here, but it is inevitably reflected in attitudes towards visualization in the present day. I suspect that part of the problem also lies in the apparent 'newness' of digital visualization. To counter this I will seek to establish a context for digital visualization in established scholarly method. The discussion will then proceed to the problems that that 'newness' presents and, finally, some guidelines to ensure the intellectual integrity of digital visualization work.

2 Visualization in the Digital Humanities

There are many ways of structuring an examination of the use of visualization in the humanities; by discipline, by type of information structure, and so on. To set the context for this article, I have chosen to look at the type of data that is being visualized. I will not discuss them in depth here as the purpose is to indicate the scope of the visualization methods that I am referring to. In practice, the boundaries of each data type are blurred and each has an importance beyond its immediate scope, but a starting point could be as follows:

- Space—the study of spatial relationships and a sense of place occur in many humanities disciplines. This area is dominated by Geographical Information System (GIS) software which was developed for scientific data that exhibits a high density of precise information, but is not ideally suited to the more sparse 'fuzzy' quantitative or qualitative data used in the humanities. From a humanist's viewpoint, it is interesting that Denis Wood argues that the impulse to

write history and to draw maps (geography) sprang from the same source; the need for early civilizations to control their societies (Wood, 1992). Maps are thought of as spatial devices but there is also a temporal as well as spatial dimension to the need for such civilizations to record qualitative and quantitative information. Digital dynamic maps are one of many alternatives offering media that are better suited to humanists (Jessop, 2006). In digital visualization tools such as GIS, or projects such as the *Valley of the Shadow*⁷ or *Salem Witch Trials*,⁸ there exists a form of visualization that combines time, space, quantitative data, and qualitative data. The Electronic Cultural Atlas Initiative (ECAI)⁹ with its utilization of Timemap¹⁰ provides an indication of possible future trends. The study of the human use of space also finds expression through the discipline of *Space Syntax*,¹¹ which originated in the fields of architecture and urban design to assess the social effects of different designs for living spaces (Hillier and Hanson, 1986). In recent years, it has been applied by archaeologists and anthropologists, among others, and is pertinent to another aspect of visualization; the application of 3D visualization to studies of cultural heritage in Virtual Realities. However, space is important not only because of the obvious spatial data applications of maps and GIS but also because it is at the heart of *all* visualizations. The process of visualizing information always involves spatializing data even when that data may not be intuitively spatial. For example, the data used by John Burrows to plot graphs of idiolects in the novels of Jane Austin (Burrows, 1987) is not intuitively spatial but space must be introduced into it in order to explore patterns and relationships within the data through visualizations such as graphs. Spatialization adds extra dimensionality that is absent from written language and in doing so facilitates the display of simultaneity.

- Quantitative data—quantitative analysis and visualization has been an established tool in many humanities disciplines for a long time. It can be found in generic statistical analysis software or embedded in specialized applications

such as those used in text analysis. It is gradually permeating into new areas of the humanities through work such as that of Franco Moretti who has argued for a wider application of quantitative methods in disciplines such as literary history (Moretti, 2005).

- Text—a great many of the visualization methods applied to text are derived from analytical quantitative methods that were originally borrowed from the sciences. This is an interesting area of application because there are also other more imaginative visualization tools that owe more to the arts than the sciences. Projects such as TAPoR¹² combine these seamlessly in a single resource for the community. Visualization techniques using tables and graphs have been commonplace in text analysis for many years. These are sometimes variants of statistical visualizations of numeric data (as in word frequencies), but in other cases they are more specialized visual forms of text analysis. Projects such as TAPoR and NORA¹³ are developing imaginative new visual forms and applications. These new methods apply not just to the visual representation of the results of analysis, but also to the visualization of the texts themselves. The aim is to support interpretive scholarship by allowing areas or relationships of interest to be identified within large volumes of text. Projects have explored specific texts in this way for many years, for example *Dante's Inferno*,¹⁴ but there is substantial scope for a tool that could be applied to *any* text. The use of the word 'tool' here should not be taken to imply that this is a computational problem as the problems being grappled with are conceptual not technical. For example, what is a text? How should it be displayed visually? Humanities computing provides a myriad of possibilities of representation; uni-dimensional or two-dimensional physical objects, abstract objects showing relations among words or between words and annotations, and animations. Further questions arise from this work; is there a need for representational as well as interpretive markup? What are the relationships between text visualization and the interpretation of texts? The visualizing of texts is

also an area which links humanities computing work to the arts; for example the interactive installation *Text Rain*¹⁵ by Camille Utterback and Romy Achituv. There is a movement towards tools in which aesthetics are as important as analysis, which in turn draw the humanities closer to the arts. The material culture of textual objects also offers opportunities for visualization, for example in manuscript studies and projects, such as *Turning the Pages*¹⁶ at the British Library.

- Time. Tools such as timelines allow one to explore the development of complex historical events and the inter-relationships between precursor events. They are of obvious value in the study of history, where later events build upon earlier ones but they can also be applied elsewhere. Historiography and literary criticism are both histories of accumulated comments on a subject. Matt Jensen has developed a number of timeline tools which are intended to answer the styles of questions that are asked by humanists; for example in the case of political scandals, questions of the style 'who knew what and when', or for exploring the response to an author's writing over a period of many years (Jensen, 2003, 2006). Before Denis Wood wrote of the links between geography and history, the eighteenth century historian Jacques Barbeau-Dubourg saw history as the study of two ancillary fields; geography; and chronology (Wainer, 2005). At that time geography was a relatively young and rapidly developing discipline and he believed that the processes of visualizing geography through cartography had many parallels with the visualization of time which would, he believed, continue to develop in parallel with it. Sadly chronology, perhaps better termed *chronography*, did not develop as a distinct discipline as both geography and cartography did. However, a study of the visualization processes of map making does allow one to draw out some general principles of visualization. The challenges tackled by cartographers in the representation of 3D space on flat print media became an order of magnitude greater when a further dimension, that of time, was added. Despite this there are

a number of successful examples from the past; for example Charles Minard's 1861 narrative graphic of Napoleon's ill-fated campaign against Russia in 1812 where time, geography, and quantitative data are presented in such a way that the scale, location, and timing of the loss of Napoleon's troops during the entire campaign can be assimilated at a glance (Robinson, 1967; Tufte, 1983, 2006). In many respects, this style of graphic has been neglected since the advent of digital tools because the techniques used to construct diagrams of this type are not easily implemented in software. They are, however, of enormous value to the humanities in the study of narratives and the relationships between people, events, and artefacts.

- 3D Visualization—much of this work has centred upon visualizations of the built environment. This is of interest not only to historians and archaeologists but also to anyone who seeks to find out how the buildings of the past worked in human terms. For example, the Theatre of Pompey¹⁷ and Theatron¹⁸ projects are based on historical and archaeological data but are primarily of interest to scholars of theatre studies. The 3D visualization is of special interest in the context of this article because the sophistication of its imagery and advanced applications can make it a form of visualization that is vulnerable to criticisms of a lack of intellectual rigour (and where the absence of an established scholarly apparatus poses most problems). To counter these criticisms a great deal of work is currently being focused on defining not only good practice (ICT Methods Network¹⁹), but also principles for maintaining the intellectual integrity of such work, for example the London Charter.²⁰ This work, especially documents such as the London Charter, may therefore provide pointers for similar work in the development of a broader field of humanistic visualization.

Any demarcations between the applications of visualization in different disciplines are misconceived as there is a great deal of common ground. This offers considerable potential for the digital humanities and it is here that attention needs to be focused if digital visualization is to achieve

recognition as a rigorous intellectual activity in research and teaching.

3 A Context for Digital Visualization in Humanities Scholarship

Establishing a context for digital visualization and the use of images in the humanities is important for two reasons. First, to demonstrate that the approach is not entirely new and that there are precedents that can be drawn upon. Second, as visualizations are a subset of images as a whole if the acceptance of visualization as a scholarly activity suffers from the attitudes held towards images in general, where can one look for more positive examples of the use of visual sources?

David Staley identifies six types of representational and abstract visual secondary sources that are used by historians but his taxonomy (Staley, 2003) applies equally well to all humanists. His categories are as follows:

- Galleries of images.
- Museums and collections of objects.
- Film, television, and other moving images.
- Dramatic re-creations.
- Maps and atlases.
- Pictures of data.

To these I would add a further category:

- Single images.

His contention is that these visual structures are as useful as verbal structures in organizing our thoughts about the past and communicating these thoughts to others.

In this context, *galleries of images* are not simply collections of images but they are visual displays in which the spatial arrangement of visual primary sources takes precedence over the linguistic arrangement of any written sources associated with them. Information is communicated to the viewer through the images and their deliberate juxtaposition. The careful arrangement of these images allows viewers to discern patterns and relationships. Photographs in scholarly publications are frequently used as

surrogates for primary sources and they generally feature a written caption that identifies the source, makes a comment of interpretation, and hints at ways that the visual source relates to the written account. Images are usually used singularly or if used with other images there may not be a meaningful arrangement or juxtaposition between them. David Hackett-Fischer's *Liberty and Freedom: A Visual History of America's Founding Ideas* is an eloquent and scholarly discussion of the development of the ideas of liberty and freedom in the United States (Hackett-Fischer, 2005). The book is heavily illustrated and makes extensive use of images to explore the iconography associated with those ideas. It constructs a visual history but only very rarely does it juxtapose images to impart new meaning. The images are usually presented singularly and isolated within the text, effectively being surrogates for primary sources. If primary sources are the artefacts themselves and secondary sources are arrangements of those artefacts, there are occasional secondary sources in Hackett-Fischer's book when images are placed alongside each other to allow comparisons to be made. Thus because the arrangement is purposeful they show evidence of the author's syntactic choices, omissions, commissions, arrangements, and analysis, and so become part of a visual secondary source. By comparison, John Berger's (1972) *Ways of Seeing* contains a number of 'visual essays'. These 'essays' have no words, only a collection of paintings arranged in such a manner that the viewer is invited to see patterns for themselves. The skill and knowledge (and scholarship?) of the author is expressed through the selection and arrangement of the images. Berger confirms the value of these visual essays as scholarly communication and inquiry when he says they are intended to raise as many questions as the verbal essays that are also present in the book. So simply displaying visual sources is not sufficient for status as a visual secondary source; there must be some sort of purposeful arrangement or juxtaposition of several images.

The origin of *museums and collections of objects* in Western culture can be traced to the 'cabinets of art and curiosities' or *Kunstkammern* that were popular between the sixteenth and eighteenth centuries. These were collections of a wide variety of objects

ranging from natural materials to flora and fauna, and manmade objects. The intention of the creators was to collect as many objects from the natural world as possible; by displaying natural and man-made objects together, creators of *Kunstkammern* sought symbolically to possess and understand the diversity of the outside world. They were intended as spaces that would bring order and systematic *thought* to the collected objects. These were not simply jumbled collections of artefacts; each object was carefully placed in a conscious manner. As with modern digital visualizations their creators were seeking patterns and associations between the objects. The *Kunstkammern* were primarily tools for enquiry and can thus be considered a type of visual secondary source. Many academics found them useful for theoretical reflection and saw them as models of the universe where the patterns of the natural world could be visually displayed. What is interesting is that the mode of thought being used was visual and associative not linguistic and logical (or analytical). Few would dispute that museum displays are not merely artless collections of primary sources, their success relies upon the conscious arrangement of objects into meaningful patterns. This is a process very similar to arranging the material for a written monograph about the same sources. In both cases researchers must make compositional decisions regarding what to collect and what to ignore. Decisions must be made concerning the placement of the objects, their juxtaposition, how they should be lit, the design of the setting, and many other issues of compositional style. They are an abstraction that has been built with the application of considerable scholarly, and other, thought and knowledge derived from the analysis, interpretation, and synthesis of primary and secondary sources, and can thus be regarded as secondary sources themselves.

To understand the importance of *film* it is necessary to examine another type of experience first. When one attends a theatre one might expect to gain some real understanding about human nature from the people, places, and events that unfold upon the stage. It is understood that what is being observed is not reality, but that one can learn from it all the same if it is meaningful in a way

that takes it beyond mere entertainment. Staley describes this as a 'useful fiction' (Staley, 2003); the play can be viewed as sharing characteristics with a scientific (or humanistic) model in that 'it describes a much simpler universe by including some features of the actual universe and neglecting others. It is an abstraction, a model, of reality not the reality itself' (Staley, 2003). It can be said to be 'useful' if it generates insights. Film, like theatre, can also depict vision, sound, speech, body language, and movement simultaneously in one medium. In so doing, it approaches what Arnheim calls the 'four-dimensionality of reality' (Arnheim, 1969). In a text-based piece the processes of selection and abstraction applied during the writing of a monograph also make it a useful fiction. Film does, however exhibit a characteristic that also afflicts many digital visualizations, in that it is difficult to display scholarly apparatus, such as bibliographies, footnotes, and information about context and content. The space available here does not permit a discussion of the final four categories (dramatic re-creations, maps and atlases, pictures of data, and single images), but each has different contributions to make to a discussion of the historical context of visual sources and tools. Their creation represents valid scholarly activity and forms a continuum to which digital visualizations are a relatively new addition. Museum displays, films, and re-enactments are all visualizations that can capture more of the rich multi-dimensionality of human experience. They do, however, suffer from the bane of humanities research: the incomplete record. This suggests a significant weakness of digital visualization which will have to be addressed if its scholarly status is to be ensured. Visual sources present the viewer with a complete, and convincing, picture that is often derived from an incomplete record but the nature of the media used often requires that the gaps be filled during its creation and thus concealed. If the applications of representational and abstract visual secondary sources are to be regarded as anything other than mere entertainment it must be ensured that viewers are aware of not only what is present but also what is omitted and the levels of uncertainty of that which is present.

The preceding discussion shows that the principles behind digital visualization are not new and that there is a precedent for the use of visual sources and visual tools in humanities scholarship. Digital visualization can be placed in context with established methodology and, in common with the digital humanities as a whole; it forms part of a continuum of scholarly method not a revolutionary upheaval of it.

Despite its location in the spectrum of accepted praxis digital visualization, and perhaps all digital humanities methodology, does face significant problems because of its youthfulness. Among these problems are:

- The lack of a historical background involving lengthy discussions of theoretical issues and methodology.
- Measures to ensure the transparency of method, processes of selection and omission, missing data, etc.
- A lack of in-built scholarly apparatus.
- A small community of users and practice.

There are other more pragmatic problems but as these have already been discussed elsewhere in a different, but highly relevant, context (Jessop, 2008) I will focus primarily on the first two issues from the above list. However, before discussing these the issue of visual literacy needs to be addressed.

4 Visual Literacy in the Arts, Sciences, and Humanities

I recently attended a workshop which brought together visualization practitioners from science, engineering, visual arts, performing arts, and the humanities. The workshop sought to find intersections between the visualization methods and applications of the diverse disciplines represented there. The technology is largely common to all and there is a great deal of overlap in the methods applied, but it was the *differences* in the aims and views of participants and of their work that I found most illuminating. There are clearly differences in the methodologies and aims of the three main groups

with the sciences being analytical, the arts being creative and expressive, but what of the humanities? My research concerning the use of GIS in the humanities has shown me something that I believe to be true of digital visualization as a whole: that potentially its greatest value is not for analysis but for synthesis and modelling. It can be used to draw material together, compare and combine it, or to construct models of how, for example, space was used in the public areas of Ancient Rome, or develop tools for the more abstract use of space to visualize data that is not intuitively spatial. This is an optimistic vision of the future, but there is a very fundamental obstruction and limitation to the progress that can be made.

The aims and working practices of the artists representing the *3D Visualization in the Arts Network (3DVisA)*²¹ caused me to rethink the nature and potential of digital visualization in the humanities. Years of school life, and many of adulthood, are spent mastering written language but the western education system places little effort, or value on, teaching visual literacy. The natural expectation of an artist who wishes to work in digital media is that they will spend many years mastering the medium. This is time that, in the past, they would have spent mastering not just the techniques but the ‘language’ of drawing, painting, or sculpture—but what is this language? In the nineteenth century the Bauhaus movement attempted to define a language of visual communication and artists such as Paul Klee and Wassily Kandinsky produced detailed accounts of their efforts (Kandinsky, 1979). Well-respected guides such as Donis A. Dondis’s *A Primer of Visual Literacy* (Dondis, 1973) were published and became standard texts for the education of artists. Semioticians have also tried to formalize a language of visual images. Jacques Bertin proposed a system similar to that of Dondis in which the visual marks that make up images are structured by one or a combination of variables of shape, texture, value, colour, size, and orientation (Bertin, 1967/1983). His study went beyond artistic and graphic design images to consider a wide range of visual compositions that encompassed two-dimensional visualizations such as maps, diagrams, and charts. Thus, it must be noted that during their education

digital artists are not spending those years learning how to use the technology, but rather the time is spent learning how to express oneself and *communicate* through digital visual media. They are taking that time to learn the 'language' of creative digital visualization. Taking a parallel example from the sciences, how many of us would be able to understand a blackboard covered with notation written in one of the chosen 'languages' of the scientist, advanced mathematical formulae? Scholars in each area have spent many years mastering their respective communication media, using 'language' which can only be understood by others who share the same knowledge and experience of that medium. Humanists have similar knowledge and skills for the use of written language but little in the way of visual literacy, but still expect to be able to make effective use of images, in the form of visualizations, to explore and communicate ideas with very little (if any) additional study. That people so frequently succeed in doing so is commendable but how much more could they do if they had higher levels of visual literacy? Our education system equips our students, and ourselves, with a worryingly low level of visual literacy to cope with an environment that is increasingly dependent on visual media. I have observed a low level of awareness of the meaning of even simple graphics among my students. There is a strong argument for increased provision of visual literacy education alongside any drive to exploit digital visualization. At the very least this situation demonstrates the necessity of expanding the multi-disciplinary teams involved in humanities digital visualization projects to include professional artists. Their contribution cannot be dismissed as being merely 'aesthetic' for those aesthetics are deeply embedded in the effective use of the medium of digital visualization.

5 A Framework for Scholarly Standards in Digital Visualization: The London Charter

If the characteristics and research outcomes of digital visualization satisfy the roles of the discovery, exchange, interpretation, and presentation of

knowledge (which I believe it is clear they do), the problem becomes not one of 'is visualization a scholarly activity?' but 'how can the integrity of its scholarship be ensured?'

One of the most visually exciting applications of digital visualization occurs in the research and communication of cultural heritage. It is an area in which three-dimensional visualization is being employed in a wide range of contexts and provides a useful case study. If the full potential of the methodology is to be realized it is essential that ways are found to ensure that such work is intellectually and technically rigorous. In this instance, the need is to establish standards that are responsive to the particular properties of 3D visualization; however, many of these standards would be more widely applicable to other branches of visualization, and indeed the application of digital tools to cultural heritage and the digital humanities in general.

The cultural heritage community has been applying 3D modelling and Virtual Reality for a number of years. Many publications have arisen from this work and an active community of practice has developed. All recognize the importance of ensuring that visualization methods are applied with the same intellectual rigour that guides traditional, and other digital, scholarship. At the core of any discussion is the need for visualizations to accurately convey to users the distinctions between evidence and hypothesis, and between different levels of probability. The London Charter is a 'work in progress' established by members of the digital cultural heritage community to tackle these and many other issues. The Charter 'aims to define the basic objectives and principles of the use of 3D visualization methods in relation to intellectual integrity, reliability, transparency, documentation, standards, sustainability, and access'.²² The field is changing rapidly and encompasses an expanding range of research aims so the Charter sets out not to prescribe specific aims or methods but rather to establish a set of 'broad principles for the use, in research and communication of cultural heritage, of 3D visualization upon which the intellectual integrity of such methods and outcomes depend'. Its aims are to:

- Provide a benchmark having widespread recognition among stakeholders.

- Promote intellectual and technical rigour in such uses.
- Enable appropriate evaluative criteria and methods to be determined and applied.
- Stimulate debate on methodological issues.
- Offer a robust foundation upon which specialist subject communities can build detailed standards and guides.
- Ensure appropriate access and sustainability strategies are determined and applied.
- Enable 3D visualization authoritatively to contribute to the study, interpretation, and management of cultural heritage assets.

The Charter addresses these objectives through eight principles:

- (1) Subject communities
- (2) Aims and methods
- (3) Sources
- (4) Transparency requirements
- (5) Documentation
- (6) Standards
- (7) Sustainability
- (8) Access

All of these are relevant to the maintenance of high standards of scholarship in any digital humanities activity, but four are particularly pertinent to this article: aims and methods; sources; transparency requirements; and documentation.

5.1 Aims and methods

3D visualization methods are used to achieve a wide range of research and communication aims in the cultural heritage sector. The visual impact and appeal of the methods must not be abused or allowed to seduce the viewer, rather a 3D visualization should only be used to address an aim when it is the most appropriate and effective available method for that purpose. This is true of many visualization methods, right down to the level of producing a graph with a small data set when in fact a table would be a better device to use. What is required is a systematic evaluation of the suitability of the method. A great deal of the work in the digital humanities is innovative so there are often no precedents on which to base such decisions. In these cases 'the choice of method should be

made carefully, based on the best available knowledge and experience, and be reviewed periodically, resources permitting, as the research process progresses'.²³ One further point is that it is important that the project documentation records *why* the choice of a particular method was made thus making it easier to defend or review the research process. This is echoed in the design of projects, such as TAPoR,²⁴ which include mechanisms to record process and intermediate results as well as final outcomes (rather like the paradigm of scientific research, or indeed the assessment of artists in training).

5.2 Sources

Scholarly practice stresses the importance of identifying and evaluating sources in a structured way. This is equally important when ensuring the intellectual integrity of digital visualization methods and outcomes. The sources must be evaluated as rigorously as they would be for the production of any secondary or tertiary source. One of the items in this section of the Charter leads on to the next point 'Careful consideration should be given to the aims and contexts for both visualization creation and dissemination in order to determine whether, or to what extent, the sources considered and the rationale for their interpretation, should be published with the visualization outcomes.'²⁵

5.3 Transparency requirements

Images are seductive and there is a natural tendency to instinctively believe whatever one sees with one's own eyes but in the case of digital visualizations what is seen is entirely a constructed object and it is essential to also know the evidence upon which it is based. The Charter observes that 'Opacity regarding the relationship of sources to outcomes makes 3D visualization anomalous among research methods, and may help to account for the lack of recognition of 3d visualization as a valid research process or outcome in certain subject communities.'²⁶ It should therefore always be possible to evaluate a visualization independently of the authority claims of its creators. If this is not possible its significance as a research method or outcome remains indeterminable. Therefore, visualization

outcomes should be ‘disseminated with sufficient information to allow the relevant subject communities to understand and evaluate the choice and application of the method in relation to its aims’.²⁷ The Charter suggests that ‘Sufficient information should be provided to allow 3D visualization methods and outcomes to be understood and evaluated appropriately in relation to the contexts in which they are used and disseminated.’²⁸ This is broken down in to:

- The kind and status of information the visualization represents including the nature and degree of factual uncertainty of a hypothetical reconstruction.
- It also recognizes that the type and quantity of transparency information will vary between projects and at different phases of the same project.

New scholarly apparatus similar to those used for textual scholarship must be developed and applied. The medium employed to implement this apparatus need not be textual, what is important is that the method of providing the transparency information should be the most appropriate available whether it is graphical, textual, video, audio, numerical, or combinations of these. The varying levels of experience and knowledge in different parts of the community mean that the level of documentation required will vary; in particular, new and/or unfamiliar methods will require more explanation. In addition, different levels of ‘assumed knowledge’ apply within subject communities. This also implies that transparency information requirements may change as levels and sophistication of understanding of particular visualization methods rise and that these requirements will also vary between communities.

5.4 Documentation

The reuse of research outcomes in new contexts, the enhancement of discovery and access mechanisms, and facilitating interdisciplinarity are at the core of most humanities computing work. The Charter deals specifically with 3D visualization but its recommendations aim to formalize a strategy that applies to much of the work performed by digital humanists. The Charter suggests that the

‘process and outcomes of 3D visualization creation should be sufficiently documented to enable the creation of accurate transparency records, potential reuse of the research conducted and its outcomes in new contexts, enhanced resource discovery and access, and to promote understanding beyond the original subject community’.²⁹ The Charter contains many specific guidelines in this area but the overall aims are to:

- Ensure the transparency of methods by explicit statements of what was done and why. This allows the method to be assessed and facilitates reuse of the work.
- Ensure the transparency of the use of sources.
- Assist in the dissemination of knowledge derived from the project.
- To provide some of the scholarly apparatus that is otherwise missing from non-textual media.
- Open a debate on methodological and theoretical issues to compensate for the lack of a framework similar to that that has evolved over many hundreds of years for other research methods. This is complicated further by the collaborative and interdisciplinary nature of research in the digital humanities. Co-workers may lack a common episteme or set of conventions that generally characterize subject communities. It is therefore essential to reflect upon the ‘unspoken assumptions and different lexica of the different subject communities engaged in the common visualization process’.³⁰

6 Conclusion

Digital Visualization has potential applications in all areas of the humanities and can be applied to explore virtually any form of data. It does not exist in isolation; rather it is part of a continuum of visual sources and methodologies the majority of which are also relatively young and so lack the long histories of debate that have shaped other forms of scholarship. This is a significant factor impacting upon its acceptance as a scholarly activity.

In the humanities, it is accepted that texts and documents are produced as readings resulting from acts of interpretation between the reader and

the text; the images produced by digital visualizations now need to be regarded in the same way. Every representation, visual, or otherwise, is an effort to structure an argument and as such it is a rhetorical device. Although there may be a case for striving to define the visual 'language' used in this form of communication, at this stage this is a minor consideration. Levels of visual literacy are currently so low that the effort may be better spent elsewhere, such as raising general understanding of visual sources. What needs to be understood (and disseminated) at this time is the relationship between *what* is being communicated and *how* it is being communicated through digital visualizations. It is clear that visualization is a scholarly activity rich in opportunities to create knowledge. The methodology itself and the theoretical issues surrounding it are still young and lack the long history of debate that has shaped other scholarly activities. It is therefore essential that such a debate is begun and sustained; frameworks such as the London Charter will be useful in this process. The Charter and the organizations that are emerging within groups of researchers will also assist in the important process of building a community of practice.

Information graphics, and indeed images generally, are expressions of procedures for generating knowledge through the act of visualization and ways of displaying knowledge embodied in visual imagery (Drucker, 2003). Visualization addresses epistemological and pedagogical issues that are common to the digital humanities and are at the forefront of the developing discipline of humanities computing. This is a vast topic and the main aim here has been to argue the validity of digital visualization as a scholarly methodology; demonstrate that it is part of a continuum of established use of visual methods and sources in the humanities; and identify some steps that are required to ensure its acceptance as having the intellectual rigour required of a scholarly methodology.

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Notes

- 1 This is commonly believed to be based on a 'Chinese proverb' however Paul Martin Lester believes that it was in fact made up by the advert writer Frederick R. Barnard. See <http://commfaculty.fullerton.edu/lester/writings/1000pictures.html> (accessed 26 August 2008).
- 2 Wikipedia at http://en.wikipedia.org/wiki/Scholarly_method (accessed 3 September 2007).
- 3 *Ibid.*
- 4 *Ibid.*
- 5 A 'method' is taken to be synonymous with a 'technique'.
- 6 'Methodology' refers to more than a simple set of methods; rather it refers to the rationale and the philosophical assumptions that underlie a particular study.
- 7 Valley of the Shadow <http://valley.vcdh.virginia.edu/> (accessed 10 October 2007).
- 8 Salem Witch Trials <http://etext.virginia.edu/salem/witchcraft/> (accessed 10 October 2007).
- 9 Electronic Cultural Atlas Initiative (ECAI) <http://ecai.org/> (accessed 20 September 2007).
- 10 TimeMap <http://www.timemap.net/> (accessed 20 September 2007).
- 11 The space syntax laboratory at University College London describes Space syntax as 'a set of techniques for the analysis of spatial configurations of all kinds, especially where spatial configuration seems to be a significant aspect of human affairs, as it is in buildings and cities. Originally conceived by Professor Bill Hillier and his colleagues at The Bartlett, UCL in the 1980s as a tool to help architects simulate the likely effects of their designs, it has since grown to become a tool used around the world in a variety of research and areas and design applications. It has been extensively applied in the fields of architecture, urban design, planning, transportation, and interior design. Over the past decade, space syntax techniques have also been used for research in fields as diverse as archaeology, information technology, urban and human geography, and anthropology'. See <http://www.spacesyntax.org/introduction/index.asp> (accessed 30 August 2007).
- 12 Text Analysis Portal for Research (TaPOR) <http://portal.tapor.ca/portal/portal> (accessed 10 October 2007).
- 13 NORA Project <http://www.noraproject.org/> (accessed 20 September 2007).
- 14 A Visualization of Dante's Inferno. <http://www3.iath.virginia.edu/hell/> (accessed 15 October 2007).
- 15 Text Rain by Camille Utterback <http://www.camilleutterback.com/textrain.html> (accessed 11 October 2007).
- 16 Turning the Pages <http://www.bl.uk/onlinegallery/ttpbooks.html> (accessed 27 October 2007).
- 17 Theatre of Pompey Project <http://www.pompey.cch.kcl.ac.uk/> (accessed 11 October 2007).
- 18 The Theatron Project <http://www.theatron.org> (accessed 26 August 2008).
- 19 ICT Methods Network <http://www.methodsnetwork.ac.uk/> (accessed 11 October 2007).
- 20 The London Charter <http://www.londoncharter.org/> (accessed 11 October 2007).
- 21 3D Visualization in the Arts Network (3DVisA) <http://3dvisa.cch.kcl.ac.uk/index.html> (accessed 10 October 2007).
- 22 The London Charter <http://www.londoncharter.org/> (accessed 11 October 2007), p. 1.
- 23 *Ibid.*, p. 5.
- 24 The TAPoR URL is <http://portal.tapor.ca/portal/portal> (accessed 15 October 2007).
- 25 The London Charter <http://www.londoncharter.org/> (accessed 11 October 2007), p. 6.
- 26 *Ibid.*, p. 7.
- 27 *Ibid.*, p. 7.
- 28 *Ibid.*, p. 7.
- 29 *Ibid.*, p. 8.
- 30 The London Charter <http://www.londoncharter.org/> (accessed 27 October 2007), p. 8.