Towards a strategy for evaluating heritage visualizations

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Abstract

"Who you gonna' believe, me or your own eyes? " Marx (Chico) 1933

As heritage visualization grows in scope and power it is becoming increasingly important to develop criteria to judge these products. The process is made particularly difficult because such visualizations fall among and between disciplines and theoretical areas bridging, among others, history and phenomenology, science and esthetics, to pick only two possible parings. Our ability to assess visualizations is further complicated by our immersion in the visual language provided through television and the movies. With all these constraints it is still possible to see the outlines of a new set of multidimensional criteria that build on the foundation provided by the ICOMOS, NARA and London Charters, and the work of Favro, Frischer, Sanders and others.

Elements of the criteria include accuracy, engagement, verisimilitude, impact and defensibility across scientific, esthetic, intellectual, ethical, historic and architectural dimensions. This is effectively a problem in multivariate maximization and the tradeoffs between these criteria are complex, as strengthening one dimension may weaken another.

The implementation of this approach is illustrated using visualization projects from two quite different setting, one Roman (including *Ostia Antica* and Pompeii) and the second, a Native American village (circa 1400 CE) from the central Mississippi Valley of the US. Because of substantial differences in the history of the areas' archaeological investigation and theoretical differences, differential availability of historic and first person accounts, the nature of the remains and the cultural and social differences of both the past and present communities, these two setting provide an excellent comparative context to explore the issue of heritage evaluation.

***Key words**: visualization, heritage, assessment, Ostia Antica, Nodena Town*

1 A brief history of heritage visualization and the CAAs

Heritage visualization has been a significant and popular theme for the CAAs almost from the inception. Sixteen years ago, in 1993, in the proceedings from that conference there were two papers on visualization, one each by Kemp[1] and by Tavernor. [2]

In the 1994 conference proceedings there was already a critical essay on visualization by Miller and Richards[3] By 2000 there was an entire volume

[1] Deborah Kemp. "Personal computer-based three-dimensional reconstruction modeling of standing buildings." In *Computer Applications and Quantitative Methods in Archaeology 1993*, ed John Wilcock and Kris Lockyear (Oxford: BAR International Series, No. 598, 1995) 249-254.

[2] Robert Travernor. "Architectural history and computing: developing a new discipline." In *Computer Applications and Quantitative Methods in Archaeology 1993*, ed John Wilcock and Kris Lockyear (Oxford: BAR International Series, No. 598, 1995) 255–257.

[3] Paul Miller and Julian Richards. "The good, the bad, and the

on the topic (with a CD) that included thoughtful essays on assessing visualization.[4] In the 2006 CAA meeting volume Saunders[5] again has a thoughtful consideration and there are many other papers on the topic. Of course beyond the CAAs there is a substantial body of literature in both edited volume and article formats. – these include key articles by Favro[6] and, notably, the substantial body of work by Frischer and his associates – who served as the CAA host at Williamsburg. For our topic Frischer and Stinson's 2008 paper -- and the entire volume of which it is a part - is particularly relevant.[7]

Beyond these CAA examples, heritage visualization has become a significant and well-funded area in many EU countries – much more so than in the Americas. So – why yet another discussion?

2 European and versus North American heritage visualization strategies

The particular perspective of this paper is informed by what I believe to be a relatively unusual juxtaposition – that is substantive, simultaneous visualization projects dealing with both classical Roman sites and a Native American, pre-Columbian one. As the work progressed on these two I, and others, were struck by the very different contexts in which these efforts were situated and, perhaps more interestingly, the very different reactions that they elicited from the scholarly and wider audiences to which they were addressed. This all led me to develop, in an initial form, some of the ideas presented here, which I hope can be of use.

One of the two visualization projects dealt initially with the Roman city of *Ostia Antica* and later the famous site of Pompeii. Less known than Pompeii, Ostia is located on at the mouth of the Tiber near Rome, Ostia served as Rome's port. Our work focused on the site largely during the Hadrianic period. Ostia is particularly interesting as it retains substantial physical evidence of an important class of Roman architecture, the *insula*. Essentially a multi-storied apartment building, the *insula* was very common in Rome but is not well preserved there, it is both common and relatively well preserved in Ostia. This is in marked contrast to the individual residences of the better-known Pompeii.

We were fortunate to be able to conduct extensive laser scanning fieldwork at Ostia (Figures 1 and 2). Our work was part of the development of an undergraduate heritage visualization program – Visualizing the Roman City. We presented information last year on the course pedagogy at the CAA Budapest meetings.

The fieldwork generated an extensive suite of high resolution scanned architecture and architectural elements. As an aside, and subject to the approval of the cognizant Italian authorities, these data will be freely provided as part of our digital data archive.

This scanned data joined an massive corpus of existing archaeological and historic data but, more significantly for this paper, there was also extant first person accounts from the Roman period that were both specific to Ostia and to the broader experiential aspects of life in that setting.

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downright misleading: Archaeological adoption of computer visualization." In *Computer Applications and Quantitative Methods in Archaeology 1994*, edited by Jeremy Huggett and Nick Ryan. (Oxford: BAR International Series, No. 600, 1995).

[4] Juan Barceló, Mauriaio Forte and Donald Sanders. *Virtual reality in archaeology*. Proceedings of the Conference on Computer Applications and Quantitative Methods in Archaeology BAR 843. (Oxford: Archaeopress, 2000).

[5] Sanders, Donald 2008 "Why Do Virtual Heritage?" in *Digital Discovery: exploring new frontiers in human heritage*, ed. Jeffrey T. Clark and Emily M. Hagemeister. (Budapest: Archaeolingua, 2008) 427-436.

[6] Diane Favro. "In the eyes of the beholder: virtual reality re-creations and academia." *Journal of Roman Archaeology*, supplementary series 61 (2006):321-334.

[7] Bernard Frischer, and Anastaia Dakouri-Hild (eds) *Beyond illustration:2d and 3d digital technologies as tools for discovery in archaeology*. (Oxford: BAR International Series, No. S1809, Archaeopress, 2008).

Figure 1. Scanning at *Ostia Antica*

Figure 2. Portion of the results of scanning at *Ostia Antica*

Details of the scanning at Ostia have been presented in previous CAA conferences and are available on line at http://www.cast.uark.edu/home/research/visualizationanimation/visualizing-rome.html (see also http://bit.ly/3aoyyF).

The second project involved visualization of the pre-Columbian Nodena Town site. The Nodena Town site was occupied roughly 600 years ago and is located in the central US, close to the Mississippi River in the northeastern corner of the state of Arkansas. There is no extant architecture at the site, as is commonly the case for most North American pre-Columbian communities outside of the southwestern US. What is known is largely derived from excavations conduced in the first 1/3 of the 1900s and some very modest additional professional excavation in the 1970s. This situation is also not uncommon in the US, as the excavation of large pre-Columbian communities has become very infrequent over the last decades.

Figure 3. Area of Nodena town site showing ramada and house structures and proposed palisade

Figure 4. Area of Nodena town site showing ramada and house structures without the palisade

While there is not a great deal of direct evidence for the architecture or interior features at the Nodena town site, there is a substantial body of published ethnographic data for the broader area. These start with the reports of the Spanish explorer de Soto in the 1540s and are followed by early French and other European travelers. While immensely valuable, these are not narratives by the actual Native American residents and they embed the racial and cultural ideas of the period. There is a second, subtler, problem with these sources, if they are to be used to guide for the visualizations, and without using them there is precious little guidance. This is that their use, and particularly their uncritical use — implies a **non-existing pan-Indian** and an **a-temporal** suite of behaviors and activities.

Figures 3 and 4, for example show the site with and without a palisade. Excavations at the site, though limited[8] have not recovered evidence of a palisade while many of the historic reports from the area describe the area's towns both with and without these structures. The presence of such a feature has great consequence for understanding the community but as the images show its presence creates a very different setting, sense of place and experience. The alternative visualizations provide powerful insights into the impact of the palisade not only on our understanding as to whether conflict was present (a common assumption about the palisade) but the ways in which these changed the community's ambience.

While lacking a great deal of documentation the early excavation efforts, however, did recover an extraordinary assemblage of ceramic vessels and other objects. The results of work documenting these objects using close range laser scanning and their use in an innovative next-generation virtual museum was presented at the 2009 CAA conference[9] [10] [11] and can be seen on line at http://hampson.cast.uark.edu.

I believe that this fundamental difference in the nature of the evidence and the combined lack of a first person perspective and embedded racial and cultural attitudes dramatically alter the ways in which heritage visualization is conducted, or at least evaluated, in North America when compared to European investigations. Consider a simple example, we generally refer to the Nodena location as a "site" not as a town or community or village. This affects our visualization. The term "site" creates a mental template quite different from that of "town."

As the visualization efforts progressed, it became clear that the primary criteria being applied to the Nodena visualizations, at least by professional archaeologists, was the one of "scientific accuracy," which could basically be defined as that which is directly conformable with physical evidence recovered by excavation. This allows the ready creations of major structures, such as houses and the like, but leads to a somewhat lifeless and sterile setting.

[8] Robert C Mainfort Jr, Matthew Compton, and Kathleen H. Kande. The 1973 excavations at the Upper Nodena site. *Southeastern Archaeology* 26 (2007):108-123.

[9] Angelia Payne, Keenan Cole, Katie Simon, Christopher Goodmaster and Fredrick Limp. "Designing the Next Generation Virtual Museum: Making 3D Artifacts Available for Viewing and Download." (paper presented at *37th Annual International Conference on Computer Applications and Quantitative Methods in Archeology*, Williamsburg, Virginia. USA March 22 – 26 2009).

[10] Katie Simon, Angelia Payne, Keenan Cole, Christopher Smallwood, Christopher Goodmaster and Fredrick Limp. "Beyond Cabinets of Curiosity? Analysis Potential in 3D Laser Scanning and Virtual Museums." (paper presented at *37th Annual International Conference on Computer Applications and Quantitative Methods in Archeology*, Williamsburg, Virginia. USA March 22 – 26 2009).

[11] Smallwood, Scott, Angelia Payne, Katie Simon, Christopher Goodmaster and Fredrick Limp. "Lighting Systems in Three Dimensional Non-Contact Digitizing." (paper presented at *37th Annual International Conference on Computer Applications and Quantitative Methods in Archeology*, Williamsburg, Virginia. USA March 22 – 26 2009).

Figure 5. Nodena town (with palisade) at sunrise

Figure 6. Nodena town central mound and structures without palisade

By the way, to address this issue in the Nodena project we are creating a series of images, beyond the ones you see here, that add additional elements to the content and are presenting many different alternative visualized possibilities. We also present a detailed discussion providing the basis for each decision reflected in the visualization – whether derived from archaeological, ethnographic, historic or traditional community sources. For more on this see http://hampson.cast.uark.edu/nodena_3D.htm.

Figure 7. Nodena town (with palisade) at sunset

Figure 8 shows a still frame from an animation of the interior of one of the Native American structures at a nearby contemporary site (Parkin) that provides an even more advanced illustration of some of these issues. There is almost no direct archeological evidence from the site for most of the furnishings shown here but they are supported by substantial ethnographic, historic and traditional community sources.

Figure 8. Frame from animation of interior of house at the contemporary and nearby Parkin Town site

The next figures are from the Roman work, and interestingly are based on work by undergraduates who have taken the Visualizing the Roman City and Pompeii classes.

Figure 9a. Exterior of a laraium at Pompeii

Figure 9b. Interior of a commercial space at Ostia as developed by undergraduate students in the Visualizing the Roman City class

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Figure 10. Screen capture of on-line game-engine based interactive visualization

Figures 9a is a lararium at Pompeii and the 9b is an interior of a commercial space in Ostia. Following the initial work in the visualization package (Cinema 4D) the results were then exported to an on-line game engine by Prof. David Fredrick (University of Arkansas Classics Department) and his students. His objectives have been to go beyond simple images, or even animations, to web-based interactive tools that will allow scholars and others to dynamically experience the interior of Roman buildings and understand their decorative programs. Using the on-line game engine server remote users can interactively tour the structures using only a standard web browser and small (free) plug-in.

A single frame from an on-line game-based visualization of the House of the Vettii (regio VI, insula 15, doorway 1) is shown in Figure 10. The house can be visited using the on-line game engine server at http://pompeii.uark.edu/Digital_Pompeii/Enter_Digital_Pompeii.html.

Note that the decorative program in the proof-of-concept demonstration *insula* is not appropriate for Ostia but is based on images taken from Pompeii sources. Newer versions of the game-engine based project are currently focused on Pompeii instead of Ostia.

3 Assessing trade-offs in visualization

We could spend more time on a detailed comparison of these two efforts but hopefully these brief examples serve to set the stage for the objective of this article, which is to consider the larger question of visualization assessment. It became quite clear that the two projects had, at least implicitly, very different external standards being applied – so the larger question is what criteria do we apply?

At one level the question is essentially defined by the objective of the work. A visualization destined for popular consumption might be considered to have a very different standard than one focused just on scholarly objectives.

We can also take advantage of the guidance provided by national and international institutional bodies[12] [13] and the London Charter [14]

If we concatenate all these sources we get a number of criteria that can be differentially applied across a number of disciplines. The problem is that we now have a surfeit of criteria and, perhaps more significantly, these individual criteria are, or at least can be seen to be, in conflict with each other.

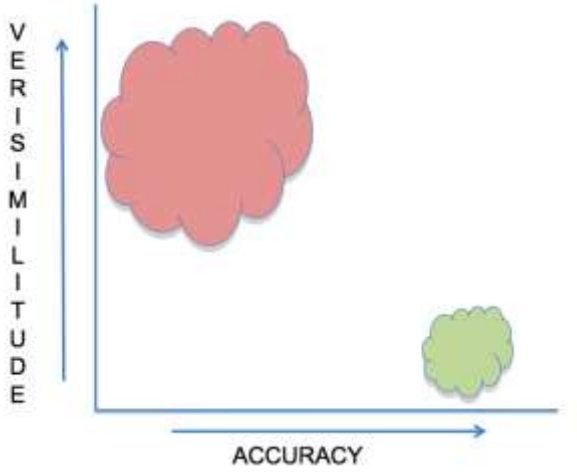

Figure 11 Schematic relationship between accuracy and verisimilitude in visualization. Using as a working definition for accuracy "degree of congruence with physical evidence."

As argued earlier, it would appear that the assessment criteria used and the sense of conflict is somewhat different when the application deals with pre-Columbian versus European archeological settings. In the two cases we've seen, it is probably fair to say that the scholarly audiences (at least) for the Nodena products are "in" (or tend towards) the green cloud of Figure 11 while the audience for the Ostia and Pompeii ones tends (at least) more towards the red one.

A more effective assessment strategy might be one that explicitly considers a common decision making tool, the trade-off curve.

Essentially the curve shows all achievable combinations of outcomes (in Figure 12 there are just two: verisimilitude and accuracy) for various combinations of inputs. If all energy, time, money, effort (whatever our inputs) are focused on just verisimilitude we can achieve a level shown by "A." Conversely a similar amount of inputs focused on only accuracy would produce the result shown by "B." Some combination of inputs might yield D, which has mid-level amounts of both outputs. Without knowing how "valuable" verisimilitude is relative to accuracy this does not allow us to say that A is better than B. If we can provide some relative comparison, however, we can then begin to formally determine how we should apply our efforts and how the outcome can be judged.

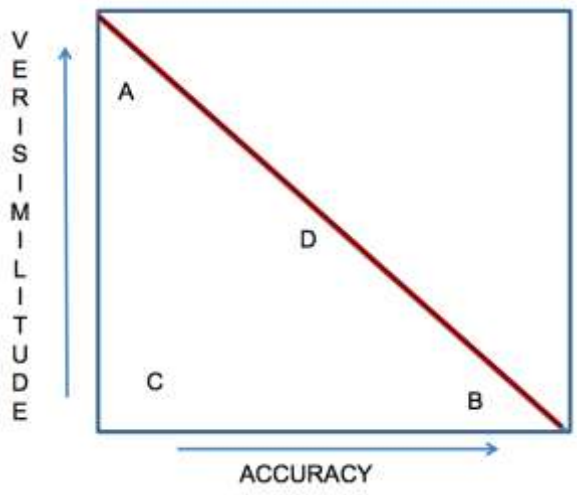

Figure 12. Trade-off curve showing relationship between verisimilitude and accuracy

It is commonly the case that the distribution of inputs towards two objectives does not yield linear relationships as shown by the straight line. Such relationships are, instead, frequently non-linear.

[12] ICOMOS *Charter for the protection and management of the archaeological heritage*. http://www.international.icomos.org/charters/arch_e.htm.

[13] ICOMOS. *The NARA document on authenticity*. http://www.international.icomos.org/charters/nara_e.htm.

[14] Richard Beacham, Hugh Denard and Francesco Niccolucci. *The London Charter*. http://www.londoncharter.org/

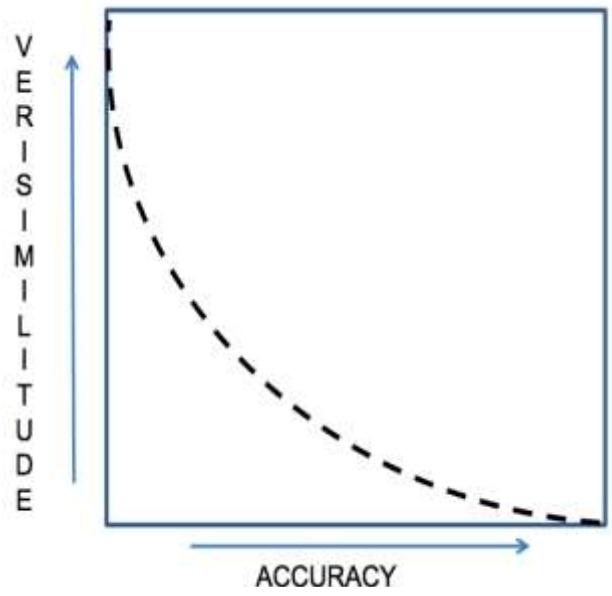

Figure 13. Non-linear, diminishing return trade-off curve showing relationship between verisimilitude and accuracy

In example of Figure 13, attempting to get a combination of BOTH verisimilitude and accuracy leads to situation where the output of each is reduced from what might be the case were we to single-mindedly focus on just one.

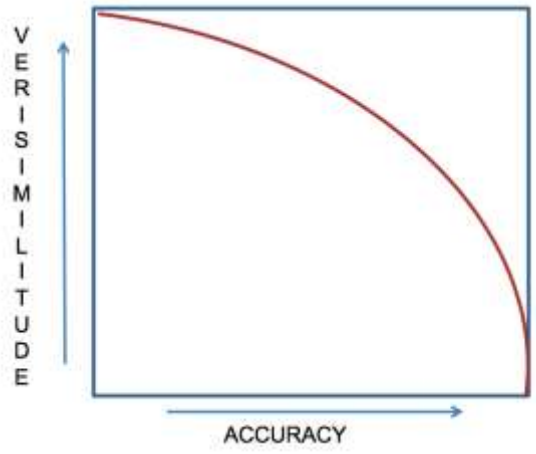

Figure 14. Non-linear, positive return, trade-off curve showing relationship between verisimilitude and accuracy

The pessimistic view of the previous figure is not the only possibility however. We can easily imagine a situation where improving verisimilitude simultaneously advances the project's accuracy (and vice versa), as shown in the concave relationship of Figure 14.

It is important to recognize that I am not so naive as to suggest that we can precisely plot numeric trade-off curves for the complex processes addressed here. I do think, however, that the approach serves as a useful way to conceptualize our assessment of multiple criteria, even if it only gets us to thinking about the relative values and the nature of the trade-offs that we are all, in fact, making on a constant basis. My view is that it cannot help to improve the situation by making these and the process explicit rather than implicit.

Of course there are not only two simultaneous criteria, a comprehensive assessment will extend the logic to some set of multiple dimensions. This again adds rigor while increasing the complexity of our analysis, yet another trade off.

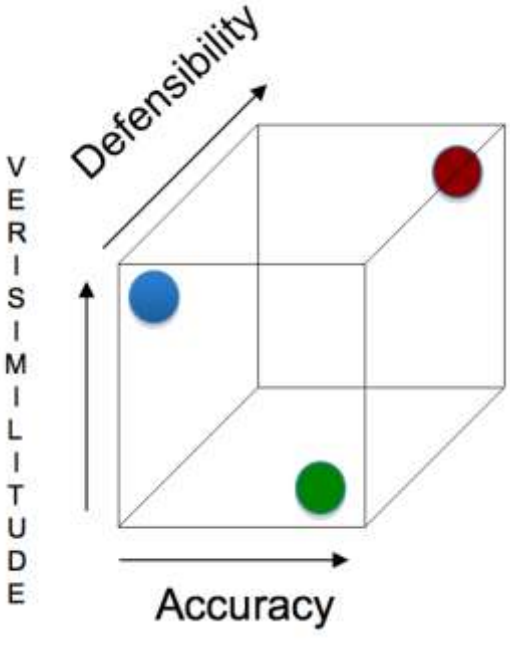

Figure 15. Multi-dimensional trade-off relationships for three criteria

Figure 15 indicates what this might look like for three simultaneous criteria. The graphic representation of more than three dimensions is not possible but can be considered in a very straightforward manner mathematically. What even a superficial consideration of the N-dimensional case suggests is that there are some distributions of inputs that yield outcomes (e.g. the sphere in the upper right of Figure 14) that are clearly superior to all other, even if we are unable to carefully measure the factors.

There are a number of initial implications that follow from this conceptualization of the process of assessment of heritage visualization.

The first is that it is essential to consider the FULL range of factors that are "in play," ranging from the nature of the target audience(s), to the amount of resources.

The second is that it important to at least attempt to provide some sense of the relative value of each. If verisimilitude is (or isn't) more important to the effort than accuracy, can you say it is twice as important?

Thirdly - consider the shape of the trade-off curves. Is there a linear relationship, or is it convex, or perhaps concave?

Using these parameters then it is possible to walk through a full assessment. This should allow us to identify obvious positives and weaknesses. We can now review the weights and other parameters and then cycle though the process again to see if the anticipated outcomes are stable or if they will vary dramatically with slight differences in weights and trade-offs.

At the end of the day the objective is not a number but a process, one that makes the decision making process explicit and attempts, in so far as it is possible, to generate the best possible combination of outcomes given the limitations of the effort.

At the least such an approach can help us to highlight and make explicit what may have been only implicit, such as the effect of the absence (or presence) of first person narratives and their impact on the visualization.

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