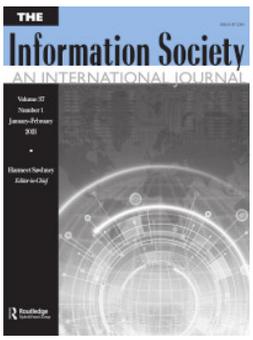

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Monstrous hybridity of social information technologies: Through the lens of photorealism and non-photorealism in archaeological visualization

Isto Huvila

Department of Archive, Library and Information, and Museum and Cultural Heritage Studies (ALM), Uppsala University, Uppsala, Sweden

ABSTRACT

The entanglement of social information technologies and their users unfolds as a problem if "wrong" users enmesh with "wrong" technologies. A long-standing debate on the merits of photorealism versus non-photorealism in archaeological visualization provides an educating example of such a "problematic" or in Haraway's words, monstrous social information technology. This article shows how a closer look at the perceived monstrosities of social information technologies can help us understand how people conceptualize information, technologies, and other people and their role in information interactions as they unfold as part of information work. It shows how a lifelike photorealistic visualization together with its spectator forms a cyborg, which is a monstrous runaway "object" when it drives with its own cultural force a programme that contradicts with other programmes considered important. The parallels in the critiques of archaeological visualizations and other informational cyborgs in information research – including search engines, information systems and services – suggest usefulness of a monstrous perspective in the analysis of social information technologies in general.

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Introduction

In archaeology, there has been a long-standing debate on the merits and limitations of lifelike three-dimensional (re)presentations of ancient objects, buildings, and landscapes. Some have emphasized the opportunities of photorealistic (re)enactments of the past for scholarly inquiry and communication), both scholarly and public (e.g., Chng 2009; Pletinckx 2013; Rua and Alvito 2011; Sims 1997). Others have criticized vivid visualizations for giving a false impression of complete knowledge of the past when only a fraction of the depicted details are based on hard evidence (e.g., Brusaporci 2016; Roussou and Drettakis 2004). In the eyes of the latter, the enmeshment of esthetically appealing visualizations and their non-specialist spectators is monstrous (cf. Haraway 1992), replacing an evidence-based image of the past with a fictive one and also undermining of critical understanding of the limits of what is knowable about the past. In addition to such advocates and critics of photorealism, there are also voices (e.g., Champion 2015; Huvila 2017; Jones et al. 2018) who have called for a nuanced understanding of the advantages, disadvantages, and monstrosity of different types of lifelike, semi-lifelike, and diagrammatic visualizations.

Building on the work of Haraway (1991) on monsters and cyborgs and by looking at the photo-realism versus non-photorealism debate in archaeology, this article delves into the question of why certain social information technologies are sometimes experienced as monsters. It shows how these cyborgs are driven by different programmes of action, and how our anxiety about a cyborg enforcing its (potentially problematic) programme without accommodating other (preferred) programmes can lead us to see it as a monster – a runaway object (Engeström 2008), following Giddens (2002) notion of runaway world, with its own uncontrollable cultural force (Hasse 2017). A close look at the perceived monstrosities of social information technologies, helps us understand how people conceptualize information, technologies, and other people and their role in information interactions as they unfold

CONTACT Isto Huvila isto.huvila@abm.uu.se Department of Archive, Library and Information, and Museum and Cultural Heritage Studies (ALM), Uppsala University, Thunbergsvägen 3H, 75126 Uppsala, Sweden.

as a part of information activities (Huvila 2013) in all human pursuits.

Hybrid agency

One of the cornerstones of cyborg theory is that agency is not restricted to human beings. This is also a premise for taking the makers and consumers of visualizations to be forming a unit. After the influential work of, especially, Latour and colleagues (Latour and Woolgar 1986; Latour 1988, 1993) and Haraway (1991) began seriously questioning the precedence of humans as subjects and actors, and the material world as an object, other scholars developed the idea of hybrid agency with slightly diverging emphases. Pickering (1993) opposes the (alleged) symmetry of Latour's approach and shows through a set of studies on the mangle of practice (Pickering 1995, see also Pickering and Guzik 2008) how material agency differs from the human one. Even if the critique misses the point in thinking that Latour is suggesting that human and non-human actants *are* symmetric (Amsterdamska 1990), when he is merely saying that they should be initially treated as such, Pickering (1995) and others (e.g., Alcadipani and Hassard 2010; Sayes 2014) have a point in emphasizing the analytical benefits of delineating differences between specific types of agents and agencies *a priori*.

In this article the understanding of hybrid agency differs from that put forward in activity theory[1] – hybridization between multiple activity systems (cf. Rheinberger 1997; Virkkunen 2006). It comes closer to Latour's (1993) notion of hybrids, entities that cannot be neatly classified either as subjects or objects. As Verbeek (2005) notes, they are both human and non-human phenomena that cannot be understood purely in human or non-human terms. For understanding hybridization and the agency of hybrids, he emphasizes the importance of understanding the processes of hybridization and purification – how hybrids emerge and how they dissolve into non-hybrid categories (Verbeek 2005).

Latour uses the example of unwieldy weights attached to room keys to explain how a hotel manager implements his *programme* of forestalling customers from walking away with keys in their pockets, against their *anti-programme* of not bothering to leave them behind. Here the weights are proxies of managers (Latour 1991). In comparison to Latour's example, the substitution of human actors is often less complete – and even in his example, it is a matter of debate whether a specific programme gets completely displaced or its effectiveness merely diminishes.

Drawing on the theorization of hybrid agency, admittedly in a limited sense and only on a small part of it, this study analyses archaeological three-dimensional visualizations as hybrid social information technologies with programmes of conveying information on things (here, archaeological) in particular ways. Having their own cultural force (Hasse 2017), they become runaway objects (Engeström 2008, 2009) that are difficult to control. It shows how dominant programmes and their anti-programmes differ among specific types of hybrids and how these differences can have a direct, both real and imagined, impact on information work in archaeology and beyond.

Monsters and cyborgs

Among hybrids, Haraway's cyborg can be seen as a specific type of crossbreed that refuses rigid boundaries between such categories as human, machine, animal, and also gender and politics (Haraway 1991). She criticizes the patriarchalist tendencies embedded in the dualistic tradition, which, among things, holds the natural-artificial dichotomy. At the same time, she turns against traditional feminism, which has according to her, accepted the conventional dualism in maintaining the essential difference between female and male. In contrast, Haraway spotlights the breakdown of boundaries between natural and artificial in the 20th century and calls attention to affinities rather than essentialism. Her cyborg theory sees the world as a chimeric blend of technology and living beings. Cyborgs bring forth completely different kinds of possibilities and limits that are not perceivable from a standpoint based on dichotomies but they have also a dark side. Cyborg unities of technology and living world are "monstrous and illegitimate" (Haraway 1991) from the perspective that refuses to accept the chimera-like hybridity of reality. Even if it is an overstatement to draw direct parallels with explicit Dracula-like monstrosity, a hybrid is a monster in the sense Cohen suggests: "an embodiment of difference, a breaker of category, and a resistant Other known only through process and movement, never through dissection-table analysis" (Cohen 1997a, x). Latour's hotel key example illustrates the hybrid agency of key-weight-guest as a unit (Latour 1991) and the movement in the experienced monstrosity of the hybrids – that of dissolving boundaries between different human and non-human agencies. If the anti-programme of a hotel guest arises out of mere laziness, the "key-weight-guest" cyborg might be acceptable to the guest; but if is motivated by a distrust on the receptionist, it

might be experienced as monstrous – exerting an unwarranted influence on how she is supposed to behave (Cohen 1997b).

Archaeology – a "discipline of things" (Olsen 2012) – is very much a cyborg itself, an enterprise that combines human intellect and cultural interpretation and the use of a broad range of technologies from trowels and measuring tapes to chemical and geophysical analysis. Moreover, it studies the human past through its material remains, which are nothing else than arrays of traces of human-technology interactions and interminglings. However, in contrast to the original theorization of Haraway (Penley, Ross, and Haraway 1990), it is difficult to characterize archaeology as producing a (relatively) comprehensive and stabilized piece or vision of social reality. As a cyborg it is in a constant state of making, marked by a contest of programmes and anti-programmes and the hybrid agency of its human and non-human constituents.

A brief history of 3D modeling in archaeology

The history of archaeological 3 D modeling is much longer than that of digital 3 D technologies (Hageneuer 2020). First drawing and painting, and more recently photographic methods have been part of archaeological documentation and thinking for ages (Adkins and Adkins 1989; Shanks and Svabo 2016). One of the most spectacular example of physical 3 D modeling is the 16 × 17 meters wide model of imperial Rome, built between the 1930s and 1970s, in Museo della Civiltà Romana in Rome. However, there are many examples of smaller models dating back to much earlier times (Guidi, Frischer, and Lucenti 2007).

The typical publicly articulated reasons for producing 3 D visualizations have not changed to a significant extent since the advent of archaeological illustration (e.g., Adkins and Adkins 1989) tothe arrival of digital technologies (e.g., Reilly 1991; Renfrew 1997; Scopigno et al. 2011). The rationale for visualizing and accompanying competing ideas of how illustrations should look like, what function they should have, and what they are supposed to convey have also remained conspicuously unchanged (Adkins and Adkins 1989; Moser 2012, 2014; Renfrew 1997; Scopigno et al. 2011). Even if visual representation has received little attention in archaeological theory, pictorial conventions and rationales of producing and using images are deeply rooted in explicit and implicit assumptions of the nature of archaeology, archaeological knowledge, and knowing. Artistic illustrations, "objective" naturalism and the ideal of "modern" and "scientific" diagrammatic imagery all their have underpinnings in the aspirations to convey specific ideas and understandings of the past – whether it is "factual" and reliable scholarly knowledge, the "meaning" of archaeological objects (Moser 2012) or a particular sense of the past to fulfill a desire to see how it looked like (Moser 1996). Apart from their role in depicting or representing archaeological things, another acknowledged key aspect of archaeological illustration is its central role in the archaeological process as means of recording, interpretation, and presentation (Moser 2012). In this respect, a visualization is as much a process as it is a product – and as Ross (2017) adds, an epistemological device.

The archetypal functions of archaeological illustrations are echoed in the rationales recorded by Marsicano and colleagues who argue that a 3 D visualization provides "a good opportunity to deepen the knowledge of the monument and to verify the hypotheses of restoration," "3 D models also represent a good dissemination tool," and "study of an accurate 3 D allows us to pose new questions" (Marsicano et al. 2017, 489). While none of the objectives are not as uncomplicated as they might seem (deepen knowledge but how, and what and how ordinary people actually learn when they are interacting with 3 D models?). In spite of claims of the capability of 3 D models to change archaeological thinking (e.g., Reilly 1991; Renfrew 1997) relatively little evidence has been published so far on how this happens in practice (Wilhelmson and Dell'Unto 2015). As Polig (2017) recently remarked, the full potential of 3 D technologies in archaeological information work is still to be investigated – much similarly to how others (e.g., Moser 2012; Smiles and Moser 2005) have underlined the need for a better understanding of the implications of archaeological illustration in general.

Photorealism as a monster

Since the advent of lifelike archaeological visualization, some researchers have underlined the potential of photorealistic renderings to convey authenticity (Hageneuer 2020) and an immersive experience in the past (e.g., Carroll 2010; Jablonka, Kirchner, and Serangeli 2003; Sundstedt, V., A. Chalmers, and P. Martinez 2004), and suggested that lifelike imaging can be used to encourage people to ask questions rather than to accept it as the final truth (e.g., Westin 2010). In some cases, it has been suggested that low-fidelity modeling can be dangerous, because of its limited capability to communicate and represent the past (Gutierrez et al. 2007). Photorealism has been

considered as "a necessary aspect of the educational and recreational value of the representation" (Roussou and Drettakis 2004, 59) whereas it may be "less important" for specialists who basically need visualizations akin to those made with traditional paper-based methods. Kotoula makes a similar remark on the usefulness of diagrammatic visualizations for "treatment purposes and documentation" and the usefulness of photorealism in public communication (Kotoula 2016, 81).

However, in contrast to the widespread optimistic claims, critical voices have warned of the possibility of lifelike models misleading their spectators. A fundamental problem with photorealistic visualizations can be, as Champion (2015) notes, that in their lifelikeness, they do not prompt spectators to look behind the graphic. In their capability to suggest authenticity, they can become a "dangerous source of misinformation" (Hageneuer 2020, 102). Even if the debate has not been pursued using Haraway's terminology, an apparent concern of the critics is that photorealism would lead to an "illegitimate" blending of technology-based visualizations and their spectators to "monstrous" chimera-like hybrids that promote pseudo-archaeology.

A major source of anxiety in the debate on the use and usefulness of 3 D models is undoubtedly the experienced difficulty in communicating a truthful interpretation of the past (Kuroczynski 2017; Richards 1998) on the basis of the little evidence that is available. For instance, a speculative lifelike visualization gives an impression of completeness even when only a small part of it is based on direct evidence. Part of the concern dates back to the experiences with the first archaeological visualization projects driven by the interests of technologists eager to showcase the capabilities of contemporary visualization technologies and less keen to focus on authenticity and correctness of the models (Sanders 2001; Sims 1997). Consequently, there has been repeated calls for the need to focus on the use of 3 D from the premises of archaeological theory and methods (e.g., Dell'Unto et al. 2017; Gillings 2000; Lock 2003; Reilly 1991; Reilly and Rahtz 1992; Richards 1998) rather than starting with technology and its affordances. Unsurprisingly, these calls echo comparable calls to bring documentation and fieldwork methods and archaeological theory closer together (e.g., Bahn 2012; Lucas 2012; Pilati 2018).

After a longstanding debate since the early 1990s (e.g., Miller and Richards 1995; Reilly 1992; Reilly and Rahtz 1992; Richards 1998), doubts on the advantages of photorealism in archaeological visualization seemed to reach a sort of a pinnacle around and after the turn of the millennium. Pujol Tost (2008) remarked critically after reviewing a selection of visualization projects that in all cases the limits of the (photo)realism of models were set by technological constraints rather than by considerations of what was feasible or usable. Martinez (2001) saw photorealism as a "a very potent thing" but considered that the same information can be passed on "without bringing what looks like accurate but misguiding 'truth' into the document" (Martinez 2001, 14). Forte and colleagues referred to the "ontological gap between the virtual and the real world that technology will never be able to transcend" and therefore suggest that non-photorealistic rendering is a better alternative to "total realism" (Forte, Pescarin, and Pujol Tost 2006, 68). Strothotte and colleagues (Strothotte and Schlechtweg 2002; Strothotte et al. 1999) found in their studies that photorealistic detail distracted spectators from focusing on the aspects the model was built to convey. Also, Eiteljorg (1998, 2000) warned that archaeological visualization can be too convincing and lead spectators to accept them without closer consideration of what they convey and what is left out.

Knight in a shining armor: Non-photorealistic rendering

Many suggestions have been made to address the concerns relating to the dangers of lifelike visualizations and to mitigate their monstrosity. There has been a lot of discussion on how to develop a working reference apparatus that is aligned with the "language" (cf. Manovich 2001) of 3 D models (Vatanen 2003), how to document the sources, inferences, and decisions in the development of a particular aspect of a model (Bentkowska-Kafel, Denard, and Baker 2012), and how to visualize and communicate degrees of uncertainty of interpretations in final models (e.g., Apollonio and Giovannini 2015; Champion 2015; Danielová, Kumke, and Peters 2016; Kastanis 2019; Reilly and Rahtz 1992). Several proposals exist (e.g., Apollonio and Giovannini 2015; Coeur and Moccozet 2011; Hauck and Kuroczyński 2015; Kolenda and Markiewicz 2017; Niccolucci 2010; Polig 2017; Ryan 2001) but there is no real consensus on the means. The difficulties of integrating highly heterogeneous data in a single framework become apparent in the implementation process (Polig 2017). However, as Huggett (2016) has noted with regard to the documentation of archaeological data, the main problem is how to make it happen in practice, rather than the lack of technical means and standards to implement it.

One of the solutions proposed to address the problems of photorealism is a method known as non-photorealistic rendering. In archaeology, this approach gained popularity especially at the turn of the century, 2000–2005. Most notably, in a SIGGRAPH panel, Arnold et al. (2004) underscored the development of non-photorealistic techniques as one of the major issues for the field of cultural heritage and computer graphics. However, since then the debate has, if not died, waned considerably. Reasons for this can be only speculated but it seems likely that the proliferation of photorealistic depiction and image manipulation in the contemporary imagery, and the indisputable benefits of lifelike representation, in spite of its drawbacks, has as a matter of fact brought acceptance to photorealism. Another possible explanation is that various options to complement rather than to substitute photorealism have gained popularity in archaeology. For instance, Frankland and Earl (2011) underline the possibility (suggested earlier by, for example, Reilly 1992) to let spectators alternate between a photorealistic view and a view with information on interpretations and uncertainty on the same model. Non-photorealism has not been abandoned but currently, it is used for specific visualization purposes rather than as an alternative for photorealistic rendering (e.g., Abu Bakar et al. 2014; Frankland and Earl 2011; Kastanis 2019). It is rather rudimentary as a method of uncertainty visualization (cf. Pang, Wittenbrink, and Lodha 1997). In a similar vein, it has been observed that just making an image non-photorealistic does not mean that it would make a good scientific illustration (Isenberg et al. 2006).

The concept of non-photorealism refers to a set of methods for producing images, which are deliberately sketchy. Visualizations are given an artistic look, which may resemble, for instance, a pen and ink drawing or an aquarelle (Markosian et al. 1997; Strothotte and Schlechtweg 2002). It has been used in explicating the assumptive nature of the surroundings presented in virtual realities (Klein et al. 2000; Roussou 2004). Martinez suggested that non-photorealism can be used to communicate same information as photorealistic visualization without creating what looks like accurate but misguiding "truth" (Martinez 2001, 14). This approach renounces the communicative opportunities of lifelikeness to avoid the perils of Eco's (1986) hyperreality, where a complete fake becomes so realistic that it becomes more desirable than the completely real it imitates. Non-photorealistic rendering does not seek to produce something that appears real and natural, but instead aims to generate an engagement with a visualization that comes close to how people interact with works of art (Huvila 2006), and even more so, how they work with diagrams and outlines. Even if much of the archaeology related work on non-photorealistic rendering can be criticized for being theoretical and speculative rather than based on evidence, studies have found differences in how spectators react to photorealistic and non- photorealistic visualizations, for instance, in both how they understand and assess them (Isenberg et al. 2006) and in their emotional response to them (Mandryk, Mould, and Li 2011).

Even if the debate on non-photorealistic rendering is singular, it has affinities with contemporary and earlier ponderings on the nature and cognitive underpinnings of archaeological visualization as illustration, abstraction, representation, and a process rather than a product (Moser 2012). Drawing on cybernetics, Forte (2004) suggested that archaeological 3 D models should aim at visualizing not only a three-dimensional space but also the geometry of information (*It. geometria informativa*) underpinning the model to help people think. The suggestion has many similarities with Reilly's proposal (1992) of complementing a visual model with a model showing a layer of data that documents the visualization and other techniques of "uncertainty visualisation" (Kastanis 2019; Pang, Wittenbrink, and Lodha 1997). Barceló linked the process of simulating the past using a 3 D visualizations to the human process of understanding incomplete sensory information (Barceló 2000). A common premise of all these suggestions is that they underline the significance of thinking as a central outcome of archaeological visualizations rather considering them primarily as communicative or (re)presentational devices.

Discussion

Archaeological visualizations as monstrous cyborgs

Even if none of the critics of photorealist archaeological visualizations directly referred to them as monsters, Haraway's (1992) take on the monstrosity and illegitimacy of chimera-like hybrids is elucidative of the criticism that they are faulty conveyors of archaeological information. Similar to what Ruivenkamp and Rip (2014) suggest of images in general, photorealistic visualizations are experienced as, hybrid monsters because "they include expectations, ranging from expectations about what entities in the world might look like, to how newly made technoscientific objects might evolve, to visions of possible entities and their functionalities" (Ruivenkamp and Rip 2014, 193). This

critique can be traced back to a refusal to see all visualizations, including non-photorealistic ones, as fundamentally complex, multimodal, and ambiguous. In contrast to how, for instance, Smithies (2017) underscores the opportunity to manage complexity as a key rationale behind data visualization, photorealistic renderings are seen as achieving the opposite. However, whenever the debate turns from the *a posteriori* implications (i.e., what can be achieved by using specific types of visualizations) to the *a priori* veracity and untruthfulness of specific types of visualizations, both the proponents and critics of lifelike imagery tend to fall back to an essentialist standpoint that declines to accept the legitimacy of the complex interdependence of visualizations and their spectators, and tries to keep human-beings separate from everything else (Hardwicke 2018). The visualizations are treated or expected to be treated as substitutes for the real thing rather than as mere depictions (cf. Stoffregen 2019) or separate entities by themselves. The proposition behind non-photorealism is that when visualizations are made less realistic, they drive a programme of promoting critical thinking, engagement, and human agency. It suggests that in a non-photorealistic setting, human spectators are kept apart from technology and they retain their agency to make sense and assign meaning to that what is being visualized. In contrast, photorealism is seen as drawing human spectators into the world of illegitimate hybridity where they lose their independent agency and ability to make distinctions such as whose programmes and anti-programmes are driven by whom or what. For its critics, a photorealistic visualization is, similar to a photograph (Myers 1990), easy to accept as a mechanical reproduction, when neither photographs nor photorealistic visualizations really are. A major concern of the proponents of non-photorealism is that lifelike visualizations undermine human-beings' capacity to interpret and think (Eiteljorg 1998, 2000; Martinez 2001). In comparison to the seeming simplicity and factuality of non-photorealism that disguise their monstrosity (cf. Law 1991), the scientific and artistic ambitions are difficult to separate in photorealism. The fear that spectators mix up these two ambitions and perceive artistic aspects of visualizations as scientific representations and vice-versa (Baigrie 1996), helps us understand why photorealism has been experienced as an outright monster.

Viewing visualizations in essentialist terms goes against a long line of scholarship of scientific and scholarly (re)presentation that has made a convincing case for the performative of visualizations, e.g., ornithology (Law and Lynch 1988), mathematics (Barany and MacKenzie 2014), physical anthropology (Kjellman 2016), and digital (Barceló 2000) and non-digital (Moser 2012) archaeological imagery and visualizations. Instead of being representations (Coopmans et al. 2014; Lynch and Woolgar 1990b), from a performative perspective, both photorealistic and non-photorealistic visualizations are cyborgs – even if they are different from each other and their embedded programmes and anti-programmes are realized in very different terms. Non-photorealism visualization is also a cyborg as it continues the diagrammatic (quasi-) paradigm (Hall 1996) of archaeological and scientific illustration directed at creating "scientific" abstractions of observed phenomena. Photorealistic and non-photorealistic visualizations are different cyborgs not in their likeness to photograph and diagram (cf. Lynch 1990) respectively but in how their geometry is made visible in "rendering practices" (Lynch 1990). Similarly, as with photographic and schematic illustrations of birds for birdwatchers in Law and Lynch (1990) study or in scientific illustrations in general (Lynch and Woolgar 1990a), it is apparent that neither of the two is *per se* closer to a more truthful or authentic human perception of the past.

Some part of the experienced monstrosity of photorealistic cyborgs can be without much doubt explained by archaeologists distrusting the capability of non-archaeologists, without "necessary" expertise, to make correct inferences from what they see. Using Goodwin's (1994) formulation, they are seen as lacking a "professional vision" or understanding of "socially organized ways of seeing and understanding events that are answerable to the distinctive interests" (606) common to archaeologists. This anxiety is not very different from the anxiety of other subject experts and information professionals when they struggle with the legitimacy of their expert position (Schultze 2000) and criticize the general population of ignorance and lack of adequate competences. As much as the failure to tame the beast can be attributed to the uncontrollability of non-experts, it can also be attributed to the cultural force (Hasse 2017) of visualization technology to impose a programme of its own on the cyborg. In contrast, the proponents of lifelike visualizations see a need for visually evocative representations of archaeological entities, and archaeology itself to be about opening a window to the past. For them photorealistic visualizations are not monstrous runaway cyborgs – but friendly hybrids that drive a healthy archaeologically motivated programme they could relate to.

From an archaeological perspective, visualizations are felt to be monstrous when they portray something that is unknown, difficult to decipher or foresee, or merely different from what its creators or spectators assumed it should be or would consider as appropriate. A monster is born of a conflict between how a visualization is expected to be looked at and how it is experienced by its spectators. The monstrosity is not in the monster itself but in the eyes of the beholder, and more specifically, in the mismatch of the epistemic and theoretical ideas and assumptions of who is supposed to be doing what when a cyborg eventually unfolds. From the perspective of archaeological theory, it is apparent that photorealism unfolds as much more monstrous against positivistic epistemologies of archaeology whereas its limitations are more apparent and as such, less risky, in an interpretative (Harris and Cipolla 2017; Hodder 2012; Trigger 2006) epistemological context. A similar cross-cutting theoretical line of division is apparent between the proponents of the exclusivity of archaeological knowledge as a form of professional capital and those who believe in the possibility to engage non-experts in a meaningful co-construction of archaeological meaning (cf. Holtorf 2015; Laužikas et al. 2018; Noordegraaf and Schinkel 2011).

Monstrosity of social information technologies

Apart from being illustrative of the perplexities of archaeological work, it is notable that the anxieties that human-technology entanglements and introduction of new social information technologies reduce the role of human agency and critical intellect are by no means specific to archaeology and visualizations. They remind of the critique of the impact of growing affective and economical dependence on search engines (e.g., Huvila 2016; Mager 2012), and more generally, on algorithms (e.g., Haider and Sundin 2016; Mager 2014; Sundin et al. 2017). Like other informational things such as search engines and information systems, archaeological visualizations are performative (MacKenzie 2006) and can be considered as cyborgs. They all are amalgamations of technologies and human-beings, wherein different programmes and anti-programmes embedded in an incomplete cyborg can compete, dominate, succumb or be in relative balance. In the context of information search, the critics (e.g., Huvila 2016; Mager 2014; Sundin et al. 2017) argue that there are signs that the programme of making information searching and retrieval easier is taking over the (anti-) programme of critical reflection and learning in the contemporary society. Similar observations have been made with regard to big data analytics (e.g., Frické 2015; Kitchin 2014), automated decision-making or "roboprocesses" (Besteman and Gusterson 2019), imaging technologies (de Rijcke and Beaulieu 2014), news videos (Woxland et al. 2017), and the adverse effects of watching television (e.g., Durante, Pinotti, and Tesei 2019; Hoang et al. 2016). Similar to how photorealism has been said to be more effective in conveying meaning and prompting reflexivity than diagrammatic approaches to visualization (e.g., Westin 2010), other informational cyborgs are said to have similar potential compared to more "diagrammatic" alternatives.

When we continue to trace further the similarities in the critiques of photorealism and algorithmic engagements with information, we find even more profound affinities between the how the proponents of non-photorealistic rendering and traditional information research (Huvila 2015) conceptualize information seeking. A foundational idea informing the advocacy for non-photorealism, shared by some of the proponents of photorealism as well, is the conceptualization of the interaction between the living world and the diagrammatic and lifelike visualizations alike in terms of information retrieval – assuming that the information should be correct and ingested as is. In comparison, the proposition that the value of (photorealistic) visualizations lies in their capacity to entangle with human reasoning (e.g., Dell'Unto et al. 2017; Westin 2010) suggest of the opposite – cyborg orientation. Unsurprisingly, the proposed methods for making visualizations resonate with the philosophical undergirding of the two perspectives. Non-photorealistic rendering – distrustful of users or spectators, and the emphasing institutional authorities – parallels with the priorities of the knowledge retrieval paradigm. On the other hand, documentation of visualization making process showing what is known and from what sources (e.g., Hageneuer and Franzmeier 2017), using paradata – data describing the intellectual and practical process of creating a visualization in different textual and non-textual forms (e.g., Bentkowska-Kafel, Denard, and Baker 2012), Forte's (2004) idea of the geometry of information, and Frankland and Earl (2011) suggestion to provide both photorealistic and diagrammatic renderings are closer to the cyborgic perspective. In different degrees, instead of trying to mediate, they can help disclose what counts as information and make it, in comparison to what Lynch (2014) notes of representational activities in general, a less contingent and more explicit as their outcome. A

potential pitfall of non-photorealism and comparable approaches is that in their desire to avoid Eco's (1986) hyperrealism – making reproductions better and more attractive than the real – they risk ending up with Baudrillard's (1996) hyperreal – a new real without a referent and origin in the reality. By over-emphasizing the distinction between data and paradata, photoreal and diagrammatic, or information and (meta-)information, the data, photoreal and information appear as unprocessed or "raw" (as in de Rijcke and Beaulieu 2014) and authentic, while paradata, diagrammatic and meta-information remain sketchy and in a sense, imaginary.

In the light of the relative popularity of the photorealistic and non-photorealistic (quasi-) paradigms, it is interesting how the debate on the virtues of non-photorealistic rendering has all but disappeared from the recent archaeological literature and, at least to a degree, been replaced by the advocacy for increased transparency of complexity and the documentation of the provenance of what is being visualized and described (e.g., Denard 2012; Huggett 2019; Kastanis 2019). At least on a surface level, these suggestions have much in common with the propositions to make information searching slower (e.g., Teevan et al. 2013), more difficult (Huvila 2016), to regulate the excessive affective dependence on specific information technologies (Huvila 2016), and to improve citizens' information literacy (e.g., Welsh and Wright 2010). With some caution, it is perhaps possible to suggest that there is an on-going shift from conceptualizing informational human-technology entanglements as potentially monstrous, impure, and unmanageable technology-dominated cyborgs to, in Latour's (1993) words, convene a Parliament of Things or trying to find means to support and endorse the emergence of "hopeful monsters" (Law 1991, 19) or friendly cyborgs that in a positive sense bring human-beings, technologies, and information together. In archaeology, some of the alternatives have already become established methods of conveying archaeological information and in a sense they have been stabilized as a mode of representation. It is, however, another question if archaeologists have become comfortable with them (cf. Ruivenkamp and Rip 2014) and if there is a reason to become too relaxed – not to mention how the situation looks like in similar contexts outside of archaeology with other sets of social technologies. The earlier and present anxieties and uncertainties relating to interacting with archaeological visualizations and information systems alike show that the there is still much work to do.

Conclusions

Even if at first glance the debate concerned the advantages and disadvantages of photorealism in archaeological visualization, the fundamental disagreement of views was clearly elsewhere. The arguments do not focus on the line between photorealistic and non-photorealistic images *per se* but on whether or not a visualization is a snapshot, former, or a diagram, latter, and what are the effective means to help its spectators understand the certainties and uncertainties on which the visualization is based. For the proponents of non-photorealistic rendering, a major source of anxiety with photorealistic visualizations seemed to be that an eventual triumph of the photorealistic programme would lead to a monstrous hybridity where human actors are deprived of their legitimate control over non-humans. From this perspective, a photorealistic visualization enforces a knowledge-made-explicit programme with a cultural force that leaves little room for human agency. For the proponents of non-photorealistic rendering, the advantage of non-photorealism lies in its capability to mitigate the risk by reducing ambiguity and cutting out all potentially unreliable knowledge that might be misunderstood. This hope of escaping the chimera-like hybridity of reality shared by the proponents of non-photorealism and also some of the supporters of photorealism, might be, however, misplaced. The long line of scholarship that has unpacked the performativity of scientific and scholarly visualizations suggests the attempts to reduce ambiguity by producing diagrammatic do not undo cyborgs. They may be different but still very much around.

Recent critique of the lack of understanding of the underpinnings of human information work (Huvila 2016) and the problematic assumptions underlying many of the standard solutions from information systems to information services and information literacy education (Sullivan 2019) suggests that the insights from the debate on archaeological visualizations are of value for the information field as a whole. The concern about over-simplication of information seeking, the increasing invisibility of its infrastructures (Haider and Sundin 2019; Huvila 2016), and the drive to use technologies to turn everything to "raw" data (Lynch 2014) do, however, flag the need for a new way to approach the problems – cyborgically. Especially when it feels the most counter-intuitive, it might be advisable to think cyborgically – try to understand the reality in all of its complexity and hybridity. In this respect the shift in the literature from the visual outlook of the rendering to geometry of information,

parallel or stepwise visualizations or paradata (e.g., Denard 2012; Forte 2004; Frankland and Earl 2011; Hageneuer and Franzmeier 2017) are a healthy change of focus. Even if the appearance of a visualization, similar to a cumbersome weight in a key, conveys some meaning, it is difficult to use precisely enough, to drive a programme, which is as complex as communicating the intellectual premises of an archaeological visualization (or something else that is comparable complex) and also how to reflect upon them. To achieve that, it is necessary to envision and furnish the spectator-visualization-cyborg with more intricate means to drive these programmes akin to critical design, as a form information making that helps to make its participants critically aware of their "everyday lives," or here in the context of archaeological information work, and "in particular how their lives are mediated by assumptions, values, ideologies, and behavioral norms inscribed in designs" (Bardzell and Bardzell 2013, 3298).

Building on Haraway, the fact that photorealistic visualizations or other social information technologies (combining human and machine in one) unfold as monstrous cyborgs means that they have a potential to bring forth a range of new ways of interacting and not interacting with information (i.e., information work practices and/or information literacies) – for both better and worse. To understand their potential and related risks, it is important to delve into the complete entanglement of diverse programmes they are driving and driven by, instead of falling back to a dualism of one programme and its anti-programme. Archaeological visualizations or information systems are, after all, seldom as simple as a cumbersome weight in a hotel key.

Notes

1. In activity theory literature, Virkkunen (2006, 66) suggests that hybrid agency is about hybridization or "a double object of activity for one actor and partially – but only partially – overlapping objects of several activity systems", which entails "collaboration between two activity systems that preserve their identity in the collaboration" of parallel activity systems.

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ORCID

Isto Huvila http://orcid.org/0000-0001-9196-2106

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