

Kinesthetic Archaeologies: Digital Methods and the Reconstruction of Movement



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Abstract Digitization, defined as the capture of data into computable 1 and 0 s, is a freeze-frame process: a digital image, a piece of text, a video or audio file are a fixed set of data that is only rendered dynamic when it is read or played, or otherwise executed. What, therefore, are the implications of digitising movement? Digital technologies and methods employed for such digitization take a variety of forms, but broadly, they can be divided into two categories: those which capture and record motion directly (such as motion capture), and those which reconstruct it (such as GIS cost pathways). This chapter will consider and compare these two classes of approach. By considering them in the context of their “digital epistemology,” it will seek to situate these two highly complementary methods between performance studies and the digital humanities. By combining historical perspectives from both areas, the chapter will offer an evaluation of how the digital capture and recording of movement can contribute to our understandings of past environments and processes.

1 Introduction: The Idea of “Retro-Documentation”

The two processes of capturing and documenting human movement in a form that can be reproduced, analysed and communicated have an interdisciplinary significance. Examples of where one needs to understand movement might include analysing past events in history and archaeology, choreography and performance studies, architecture, cartography and urban design. Doing so, however, presents numerous methodological and interpretive challenges. Techniques commonly used for the purpose include video, gyroscopic motion capture and visualisation, whether based on evidence or conjecture, of movement from secondary sources through graphical means such as mapping. More recently, we might add Global Positioning Systems (GPS) as a means for tracking human movement in real time (Barber and Sammon n.d.). At some point, all such techniques must address an inherent contradiction:

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their subject is ephemeral, transitory and above all *dynamic*, yet the form into which it is being documented is *static*. A photograph or a painting of a dancer in mid-performance, for example, records movement at one particular point in time and in a particular place, but the act of documenting those attributes at that one point repalces movement with stasis. The remediation of movement into a form in which it can be analysed, critiqued, assessed, transmitted and archived is therefore problematic both practically and philosophically.

Classical rhetoricians were preoccupied with the transmission of value-bearing objects, such as artworks, or indeed humans, into other forms. In the case of our dancer, this means transferring them from the dynamic/physical/embodied world to a static/visual/disembodied one. The branch of rhetoric associated with such transformation is *ekphrasis*, the expression of (artistic) physical objects in other forms, usually literary or spoken ones (Foka and Arvidsson 2016). Mitchell states that:

[t]he crucial rule of ekphrasis [...] is that the ‘other’ medium, the visual, graphic or plastic object, is never made visible or tangible except by way of the medium of language. One might call ekphrasis a form of nesting without touching or suturing, a kind of action-at-distance between two rigorously separated sensory and semiotic tracks, one which requires completion in the mind of the reader. (Mitchell 2005: 263).

Ekphrasis, therefore, is a form of remediation through understanding and semantic description. In order to adapt this principle to the dancer’s movement motion, whether in the past or the present, needs to be added to Mitchell’s list of visual, graphic or plastic objects. In all these cases, there is a chain of creativity and interpretation, consisting of five “links”: (1) the point (in both time and space) in which the movement is executed, (2) the point at which it is observed or captured, (3) the point at which a further “object” is made recording that movement, (4) the point at which that object is augmented or enriched and (5) the point at which it is observed and received. The idea of this “ekphrastic chain” is crucial to the arguments developed below.

This framing highlights the distinction between *capturing* the dancer’s movement and *documenting* it. The first three links in this chain (execution, observation, recording) deal with *capture*, an act that must inevitably take place in some physical and/or temporal proximity to the movement. If one tried to draw the dancer’s movements a fortnight after they executed them from memory, for example, the new object (the drawing) is unlikely to be as faithful a rendition as a drawing made co-temporally and co-locationally from direct observation. Having been captured, the movement itself is obviated or even suppressed. The last two links in the chain (augmentation and reception of the new object) refer to documentation, where the captured movement is rendered into a form in which it can be shared—and manipulated, consumed, appreciated, and critiqued—in different ways. One is a product of direct observation, physically co-spatial and/or co-temporal—and by implication containing a degree of objectivity—and the other is augmentative and interpretive. All five links are part of an ekphrastic processes, but for the purposes of this discussion, “capture” refers to movement remediated through direct observation, whereas “documentation” is a process of augmentation of the “object” thus created, in which the movement is

described with further information and/or new perspectives. This could be contextual information, other remediated movement “objects,” artistic interpretation, etc. This allows for the complexity and variety of humanistic interpretation: what the movement means to the observer. For example, if the image is a drawing rather than a photograph, then a facet of human interpretation (the artist’s eye) is introduced. The image is a subjective rendering of the physical situation *at a particular point* between (to extend the example above) Positions A and B. One could add at this point other material or metadata, such as a choreographer’s instruction, or a critic’s comments, interpretations or explanations of that particular section of the movement’s meaning.

Framing the capture and documentation of movement in this way allows us to deal more easily with problems of timescale. For both capture and documentation, a significant complication occurs where there is a large temporal separation between the movement being captured, and the (documented) “object” being observed. Many would argue that it is impossible to empirically reconstruct the movement of human beings in the past, and that the cognitive, social and cultural processes which drive that movement, through a variety of means and in a variety of media, are similarly shrouded in the mists of history and archaeology. This assumption accounts for many of the sceptical reactions to phenomenology in archaeology (of which more below) (Barrett and Ko 2009), and also to experimental archaeology. It also fits into a context of more recent discussion about the “archaeology of mobility,” an approach to archaeological research which seeks explicitly to transcend the static nature of the archaeological record and recognise that it is a product of the movement and motion of multiple agents over a long period of time (Leary 2014). However, if we consider movement itself as an “object,” with the possibility of both an original (captured) and secondary (documented) manifestation in the terms framed above, and if we draw on the idea of the ekphrastic chain to trace that object’s transmission through time, then it becomes possible to think in more structured terms about the documentation we create in the process. This in turn allows us to consider how a formal understanding of motion, can contribute to broader historical, cultural and archaeological questions.

I argue below that to gain this formal understanding, we need to think of the interpretation of “captured” (with the word used in a very broad sense) motion in terms of “retro-documentation”. Retro-documentation refers to information associated with, and explicating, movement captured, whether directly or through contemporary observation, either in the past, or in the present day. In both cases, retro-documentation allows us to address the separation in time of the movement and its reception; be that scaled in minutes or seconds, or of years, decades or centuries. Thus framing retro-documentation, this chapter offers a brief overview of the histories of both the media and the standards which have been used to describe and document movement in the human record. The augmentation of past movement, whether captured or observed (be it the near or distant past) in the present with information increases its interpretive or scholarly value. This provides background and context for a discussion of the retro-documentation of motion capture, and how it can be applied to remediate and understand human movement in both the past and the present. I then reflect how “the digital,” both in terms of hardware and the physical technologies which are used to capture it overlap conceptually with digital

data standards which—as noted above—do not lend themselves to such tasks. It will be argued that retro-documentation exposes a creative tension therein which offers new possibilities for both academic researchers and creative practitioners (recognising that one individual can occupy both categories simultaneously) to document, explore and understand the role of physical movement in the human record.

2 Digital Capture, Digital Documentation

In theory, the digital age has ushered in a new paradigm of possibilities for both the capture and the documentation of movement, not least by allowing contemporary direct capture in three dimensions. Most obviously, the development of motion capture equipment to record human movement directly emerged in the 1970s, as hardware in general became cheaper and more widespread (Moeslund and Granum 2001). Such technologies are now extensively employed in the creative industries, most notably film and animation. The method allows direct, observational capture of movement in real time using calibrated gyroscopic sensors to record the trajectories of the body's joints and extremities. This would enable the user to record that the hypothetical dancer's arm, for example, moved from position A to position B in Cartesian space, with both defined in an X, Y, and Z coordinate system along with all stages in between, with other attributes such as the speed of the movement. In this way, direct motion capture can recreate movement in real time, i.e. it can restore the actual movement of human body parts. It could also be observational, however, in that the data generated could be translated into commands executable by a machine, i.e. the dancer's arm movement could cause the machine to act in a certain way. In all cases, however, the equipment used for the capture and recording must be co-located with the object that is actually moving.

The use of digital methods to capture and document movement generates further questions for the ekphrastic chain. As noted above, motion is dynamic and analogue and continuously variable. Conversely, any digital file composed of 1 and 0 s, which represents a movement (for example, the X, Y, and Z coordinates of the dancer's arm) applies only to one particular series of points in time: is inherently static, whereas movement by definition encompasses and crosses multiple points in time. Like any inert physical medium, digital media is fixed, motionless and atemporal, although not necessarily aspatial. However, the whole basis of computing relies on sequences—"programmes" of such sets of 1 and 0 s running *in sequence*, itself an epistemologically new form of "motion". To put it another way, the structure of motion, like any other formal structure, can always be replaced by computer code (Dyson 2012: 275). In this case, computer code forms a series of representations of movement at sequentially differing points, but as will be explored later, the digital world, including technologies such as GPS and the GeoWeb, has created a new context in which both the capture and the documentation of movement in real time can be understood.

3 Movement and the Human Record

This context relates to the capture and documentation of movement outside of real time, movement in the past, what I call retro-documentation. Despite—and in some cases because of—the methodological concerns and questions that capturing and documenting movement produces, the analysis and understanding of movement are central to many broad questions of human history, culture and society. Accordingly, different humanities domains have developed different approaches—or rather, in many cases different workarounds—to retro-documentation. In the field of history, for example, retro-documenting the movement of individuals, or groups of individuals (such as armies) is essential to the interpretation of particular events and processes; even if movement is only one part of a complex array of factors. Such examples throw into contrast the role of individuals and large bodies of interacting individuals, who may make very different contributions to larger movement macro-patterns. For example, in one application of Agent-Based Modelling (ABM), the logistical question of how the Seljuk Turkish army was able to move as quickly as it did to engage the Byzantine Army at the Battle of Manzikert in AD 1071 was addressed. In this study (Murgatroyd et al. 2012), the contribution made by individual members of the army to its overall trajectory, and that trajectory's timescale; historical factors which are known from historical sources, were modelled and visualised. Individual agents' movements, from the Emperor down the social hierarchy to the common soldiery were hypothesised according to different variables of terrain and environment (ibid). The likeliest set of historical scenarios that enabled the movement that actually occurred was thus constructed. This may be seen as “retro-documentation” of the army's movement, achieved by starting with a known trajectory and extrapolating the causes and impetuses behind it from other known data.

This highlights that for many historical scenarios, especially scenarios involving the more distant past, informed simplification is a key component of movement retro-documentation. Retro-documenting collective movement, like that of an army, inevitably involves abstracting it at scale. This is the approach adopted by the Orbis project (Scheidel 2015). Orbis, developed by Stanford University, allows one to estimate the cost, in terms of time and expense of traversing distance between any two given points in the Roman Imperial period, depending on whether the traveller is crossing sea or land. A variety of historical sources are factored in, and the cost is generated according to factors of distance, terrain, mode of transport, etc. Whilst, as with the ABM application described above, this technique involves retro-documenting hypothesised movement based on known variables, this approach allows the user to define a series of “what if?” questions, and then view mapped movement models which fit certain bespoke historical hypotheses. Both are examples of retro-documentation involving the creative blending of empirical and interpretive evidence.

As the final part of the interpretive chain, retro-documentation is inevitably conditioned by the medium in which it is executed. As noted above, remediating motion in a

static medium highlights the tension of embodiment versus separation, a core concern of ekphrasis, as Mitchell notes. Before the advent of relatively widespread photography in the nineteenth century, and then motion pictures, computing and associated technological developments in computer graphics in the twentieth, documentation of movement was inevitably undertaken on paper. It is therefore worth examining in greater depth some “milestone” examples of how historians came to use the print medium to problematize movement in this medium.

4 Recording Movement in Print

The print medium lends itself to abstraction (Ingold 2016), which in turn channels the kind of “informed simplification” highlighted in the two examples above. We can reinforce this view by turning to some early examples of visualisation used to document multi-causal dynamism which, like the Manzikert example above, can be found in the field of military history, specifically the French military engineer Jean Charles Minard’s work on the mapping of the Napoleonic wars. Minard was one of the first engineers to recognise the importance of mapping geographical location and, working in the first half of the nineteenth century, was doing so in the context of the war in Europe on an industrial scale. His *Carte figurative des pertes successives en hommes de l’Armée Française dans la campagne de Russie 1812–1813* is a masterpiece in data visualisation. It describes, in multidimensional visual form, the French advance on Moscow in 1812; an early-modern example of a large-scale military campaign, involving the movement of thousands of troops in the abstract, which may be considered an example of “flow mapping” rather than “movement mapping” (Bahoken et al. 2015). Like the movement of the Turkish army to Manzikert, this campaign is well understood in terms of times, dates and locations; but less so in terms of causes, and which processes “flowed” between static events. Minard’s map sought to deepen causal understanding by retro-documenting the army’s path with six different dimensions of analogue-dynamic data: the spatial route of the army in the form of latitude and longitudes, its size in terms of numbers of men (denoted by the thickness of the line), the temperature, distance between key events, and the army’s location in relation to specific dates and key events, such as the battle of the Berezina river. Whilst of course this map does not in any way transcend the limitations of the static print medium, it nonetheless brings these six aspects of data together in such a way that they can be meaningfully read visually and collectively on the static page. Whilst the Minard map is thus often seen in terms of its importance to the history of data visualisation (Friendly 2002), it can also be seen as a key moment in the history of conceptual flow capture and subsequent documentation.

Minard’s dynamic flow map reflects a more general nineteenth-century Eurocentric concern with the theme of Imperial and military expansion, of the fate of empires, and of how the visualisation of movement across space and time could be realised in the print medium. The possibilities of this medium, and the hyper-nationalistic worldviews which accompanied the rise of powerful (often imperial) political entities

in this period, arguable encouraged a new genre of retro-documentation. Minard's map is a one visual response to this. Another, more abstract form, can be found in a map produced some years later to accompany Emma Willard's *Universal History in Perspective*, an "Atlas, To Accompany A System Of Universal History; Containing, I. A Chronological Picture of Nations, Or Perspective Sketch of the Course of Empire" (see Davis et al. 2016). Forming part of an educational text aimed at children, this map charts the progress through time, in the form of movement from distance in both time and space to proximity in both time and space of the "great empires" of history, starting with the Creation, traditionally placed in pre-Darwinian terms in 4004 BC. Visually mimicking the flow of a series of rivers, the streams of the different civilizations appear to move towards the viewer, the visualisation seeking to provide context to the emergence of the United States after the Revolutionary War. This hyper-abstracted view of the movement through time is entirely non-spatial—or rather space (i.e. the width and length of the trails representing the empires) is rendered entirely in non-geographical and conceptual terms.

The obvious common factor for both of the examples listed above is that they represent retro-documentation of the movement of large groups at a macro level: armies, empires, traders and merchants travelling across country; and in the latter example the entirely non-spatial documentation of abstract movement through time. In many cases, it is difficult or impossible to trace the movements of individual persons in any kind of evidence-based way, or to know anything significant about the individual identities or histories which motivated that movement. An exception in the examples above might be certain points in the personal histories of the officers and senior leaders of the French army in the Moscow campaign; but in most cases the ekphrastic chain of movement > observation > contemporary documentation > retro-documentation obscures any chance of understanding the *particular* movements embodied/executed by *particular* people. So can our "ekphrastic chain" relate to individuals, or only to large groups?

5 Movement and GIS

Digital mapping tools allow such abstract and reconstructive methods for movement retro-documentation at a micro level but require different forms of hypothesised inference. Such methods include Geographic Information Systems (GIS). GIS enables researchers to interrogate data with a spatial component in different ways and has been extensively used in archaeology (Lock 2001), history (Bodenhamer 2007) and literary studies (Cooper et al. 2016). However, notably, one well-known criticism of GIS is that it generally is not effective at dealing with time, or with change through time. In most cases, GIS deploys the "freeze frame" methodologies implicit above, without accounting, or offering any basis for interpreting, movement. However, some forms of GIS analysis do seek to address this limitation of the methodology. One example is the "least-cost pathway" model, which allows researchers to estimate how much cost in terms of energy consumption and time it would take, under certain

conditions, for an individual to move between certain points, and to define a route which requires the least expenditure of one or both. One good example of the least-cost pathway methodology in action concerns an analysis of the effort required to traverse between different points of the Ridgeway path in southern England, now a national walking trail, but historically a trading route dating back until at least the Iron Age (Bell and Lock 2000). This application enabled researchers to establish that the least-cost route, and the route of the modern footpath, matched remarkably well but differed in the location of hillforts positioned along the way. In other words, the actual path for individuals more or less followed the modelled least-cost, but the sections where there were forts represented variations to this. Therefore, assuming that the pathway once connected with the forts at some point in its history (a reasonable historical assumption), this suggested that they post-dated the original route, which reverted to the original “least-cost” when the forts fell out of use (*ibid.*). This is a good example of how GIS, a methodology and class of software designed for spatial analysis, can move the discourse relating to movement forward beyond the entirely freeze-frame affordances of the print medium. This also hints at a broader significance for the digital in-motion capture and (retro)documentation, which I come to later in the chapter.

That said, however, the GIS example just described enables a deeper understanding (or at least better inference) about the significance of historical movement, and helps to explain changes it wrought in the archaeological and historical records, but it still does not address the problem of abstraction where individuals are concerned. This work may help us guess as to how an ancient traveller might have interacted with the landscape, how they came to leave their impression on it, and how it impacted on their behaviours; however, we cannot use it to retro-document individual travellers’ stories. By definition, the pathways, movements or motions of actual historical persons must be confined to scenarios where there is direct historical or literary, as opposed to archaeological, evidence. Where such evidence exists, the movement patterns of a particular individual at a particular time and through a particular place can also be reconstructed with GIS. One example is the literary description of journeys from first-hand experience. In contrast to the examples above, where the movement of unidentifiable people is documented in the abstract, GIS can be used to interrogate the experiences of actual individuals as they describe them. Such approaches hint at engagement with the phenomenological experiences of the landscapes described (of which more below); in that they seek to unpack personal experiences at particular moments.

6 Textual Approaches

In literary studies, the “eventfulness” of the processes of reading and writing is often framed in terms of bridging the distances (whether physical or conceptual) between the writer and the reader, and/or between different real or fictional characters (Hones

2008): these either concern or describe, processes of movement, yet—in the intellectual context of ekphrasis—the movement is secondary to the static description. As explored further below, in history, as in archaeology, the movements and motions of individual actions needed to construct a particular type of artefact can be reconstructed through processes of experimentation. However, in most cases these are documented as *text descriptions* of the process and the output, with a little systematic attempt to capture the movement itself.

In the case of authorial narratives describing journeys, GIS can be used as a retro-documentation mechanism for motion, framing the phenomenological experience as described by the author. This works particularly well (as one might expect) for travel literature, where the narrative is structured around a route or routes taken by the author. For example, George Jeffrey was an administrator in British-controlled Cyprus, who published a monolithic study in 1918, *Studies in the Archaeology and Architecture of the Island, with Illustrations from Measured drawings and Photographs*, which aims at an encyclopaedic overview of Cyprus’s antiquities—then of growing interest to the educated sections of the British colonial hierarchy, which assumed direct control of the island after the First World War. In his work, Jeffrey takes an itinerant, travelogue-like approach to the island, giving detailed textual and visual descriptions of significant antiquities. This in itself plays to a kind of “stop-motion” mode of writing, where the purpose and emphasis is on recording (and thus retro-documenting) particular monuments at particular places at particular times. However, if we detach the objects (= the monuments) described and focus instead on the named places, it is possible to gain a different perspective on the text. We can map one section of Jeffrey’s itinerary, for example, Chap. 9, which describes his journey between Perakhorio and Nicosia, as a composite viewshed, showing what Jeffrey (or anyone else) could have seen from the points he names. Figure 1 shows this journey, with the linear route purposefully left off, but with each place mapped at the centre of a viewshed, using a 30 m Digital Elevation Model (DEM) of the terrain. That is to say each 30 m square which Jeffrey could have seen from the points he describes is coloured in blue. This shows that, travelling up the eastern flank of the Troodos mountains, the view of this journey was predominately characterised by east-facing panoramas. This allows us to construct a more overarching, composite perspective of the experience of the journey, and not necessarily one that is tied to anything that Jeffrey wrote in particular—and thus less constrained by the print medium. GIS thus becomes, in itself, a method for the retro-documentation of a particular individual’s journey.

7 Movement: The Medium Suppresses the Message

To fully appreciate the possibilities of retro-documentation, we need to acknowledge that it does not necessarily have to employ the print or screen medium; and that, for the purposes of the “ekphrastic chain” this necessarily requires divergence from Mitchell’s view (2005: 263) that objects (in this case motion) are “never made visible

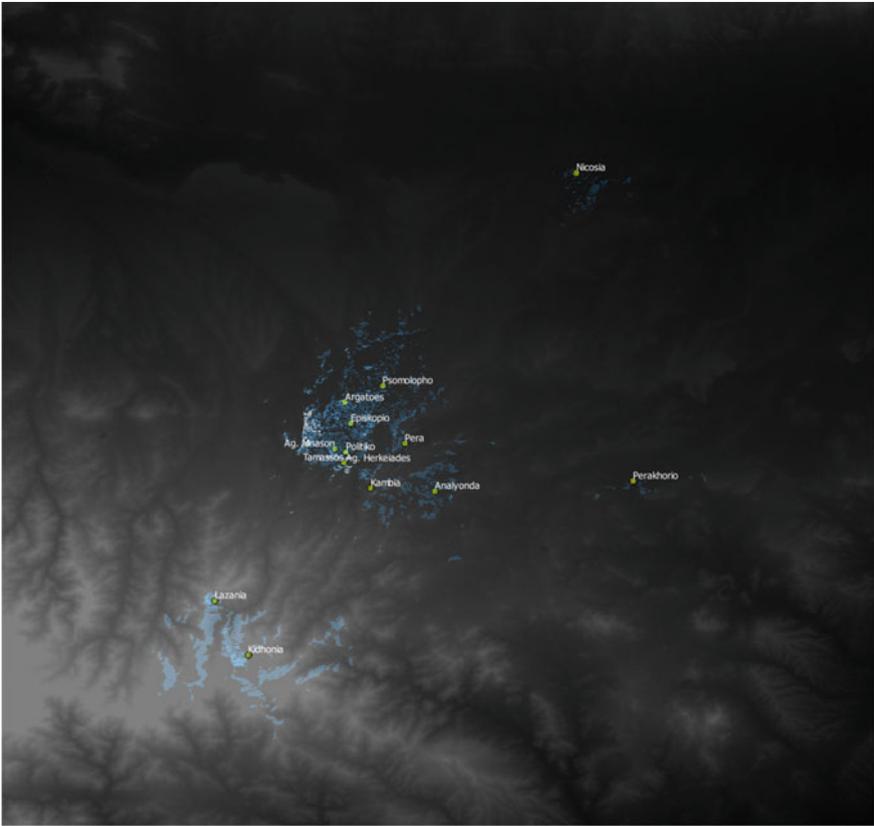


Fig. 1 George Jeffrey's Perakhorio-Nicosia journey mapped as a viewshed. The South East/North West axis of his journey becomes clearly visible as the viewshed fans out towards the east. The two aberrations to the west are caused by visits, and references, to monasteries

or tangible except by way of the medium of language" (see above). This is a truth that has been explored not only by academic researchers (of which more below), but also by myriad performance artists, choreographers, creative practitioners and dancers who have used non-textual media to convey and interpret movement. Richard Long, in his 1967 photographic work, *A Line Made By Walking*,¹ now in the Tate Collection in London, experimented with the tension between transience and permanence, and its capture through photography. The work records the line made as Long walked repeatedly backwards and forwards in a field in Wiltshire as the sun hit a certain angle and made the line visible. This not only expresses the tension between the transience of Long's walking motion and the transience of the line in the grass, but also between both of these and the permanence of the photographic medium which recorded it (see Dunn 2019, Chap. 5).

¹ See <https://www.tate.org.uk/art/artworks/long-a-line-made-by-walking-p07149>.

The illusion of pathways' permanence, as explored in Long's work, was further exposed in the Covid-19 lockdown period in the summer 2020. At this time, public social distancing requirements bought in to limit the spread of the virus required people not part of the same household to maintain a physical distance of 2 m at all times. This altered fundamental habits of pedestrianism and transience, and these found themselves temporarily etched into the landscape, in much the same way as Long's *Line* was. Figure 2 illustrates this, by showing the creation of a new path alongside an established path along the River Thames in Berkshire, UK. These examples show that not only should retro-documentation not be assumed to be always textual, but sometimes it also represents a one or more stages in a process of *embodied* documentation that can be textual, visual, embodied or all three.

These issues become more complex when tracing the ekphrastic chain back further in time, to the creation of artefacts for which there is no kind of documentation or contextual knowledge. Here, we turn to the practices of experimental archaeology, which involves the re-creation of artefacts, features or any other object visible in the archaeological record in the present day using the same materials and methods of construction identified by experiment, thus drawing inferences as to how the archaeological objects were made.

As a discipline, experimental archaeology emerged in the 1970s in the context of "uniformitarianism," the belief that processes, including movement processes, as well as cognitive and physical ones (and perhaps therefore flows, in Minard's sense), can be viewed as uniformly objective, and thus replicable. Today it is employed with a greater degree of theoretical nuance, which acknowledges the limitations, most significantly by being a critically selective as to the type of activity being reconstructed, and whether it is likely to sustain an assumption that a particular process is unlikely to have changed over time. The butchery of animal carcasses using hand tools is one example of this, as Seetah states: "butchery has remained largely unchanged as a technological exercise since its inception; what differs amongst regions, periods and groups are the socioeconomic and socio-technological drivers behind the observed practice" (Seetah 2008: 143). Experimental archaeologists thus deal with embodied action as a primary resource, within a robust critical and theoretical framework.

This is necessary for the results to have interpretive value. The re-creation of, say, a Palaeolithic hand axe in a way which causes the artefact created to reflect those which are millions of years old can only be done by physically enacting a particular series of movements which demonstrably lead to that finished physical artefact. It follows that a key limitation of experimental archaeology is the medium in which the results are, or can be, communicated. There is no empirical basis for documenting the movements that "successfully" reconstruct the hand axe by physically replicating it, nor are there even any clear criteria for what defines "success" (i.e. showing that the process reconstructed and enacted by the modern archaeologist definitely the same process as that originally enacted in the distant past). To frame the question in the terms of the discussion at the opening of this chapter, if an ekphrastic chain begins with the creation of a hand axe in Tanzania in 900,000 BCE, how does experimental reconstruction end it in the twenty-first century? It can take the form of entertainment (one thinks of the opening scenes of Kubrick's *2001: A Space Odyssey*, which



Fig. 2 Diverging pathways as a result of the 2020 Covid-19 lockdown illustrate the collective/accidental capture, and retro-documentation, of human movement in the landscape. Here the “insurgent” pathway re-joins the established one as they both have to negotiate a narrow gap between a field boundary and the river

re-enacts the initial invention of bone tools by pre-human apes), or of public education. However, in order to constitute methodologically solid archaeological inference about the creation of tools, documentation and replicability are required. There is no critical documentation framework where, for example, information about the sensory experience of the creator (who is likely to be a highly skilled and trained technician) might be recorded, or cross-referenced to other attempts to recreate the same process (except with video); nor is there any way of ensuring that the sequence enacted is the “right” series of movements.

This is a limitation which is fully recognised within the discipline of experimental archaeology. John Coles states the matter succinctly in his book *Archaeology by Experiment* (1979), which laid the theoretical groundwork for the field:

A multiplier effect applies here: if the action of B and only B upon material A produces an answer Z, then the inference is that B might have been the only method in the past to get Z. However, if Z is also produced by C, and perhaps D as well, then the possibility exists that any one of B, C or D might have been used in the past to get Z. (Coles 1973: 15).

Despite the clear differences in scale and content, a formally documented academic argument (as expressed in a research paper for example) would require the kind of narrative structure we saw unpacked in George Jeffrey's Cypriot itinerary, encoding provable statements based on cited evidence; however, when it comes to the deployment and impact of movement and the results thereof, such statements cannot be made. They also cannot be expressed in written form. Rather, we might characterise formal descriptions of the production of artefacts produced by experimentation to the descriptive narrative, of the sort found in other genres. One might put it another way by asking what, in the experimental movement-based reconstruction of Palaeolithic hand axes, is the equivalent of academic citation?

Both the literary GIS case of Jeffrey's journey, and the case of experimental archaeology require retro-documentation to transcend the constraints of the textual narrative form. This means transcending an implicit Cartesian and Westernised form of movement's spatial representation; and becomes even more apparent when we turn to the retro-documentation of movement in non-Western societies, which do not make the same sort of use of Cartesian or formalist structures to create understanding. Indeed the art history of non-Western cultures, including the art histories of pre-literate societies, often rejects such linear literary assumptions. It is possible to detect in those societies' artistic practices approaches to movement which reflects their own cultural outlooks—which may differ markedly from Western world views, and the Cartesian approaches to mapping movement which often goes with these.

The study of aboriginal rock art is an excellent example of this. In particular, in Australian rock art iconography, much emphasis is made on the emplacement of the art, of the fact that it is immovably anchored to a particular location, which contrasts with the non-settled nature of the communities which produced it. Westernised interpretations of the art which fail to take into account the nomadic lifestyle and culture of the societies which produced them leads to what Ursula K. Frederick calls a "site-focussed and sedentarist line of thinking" in the historical and cultural understanding of the art. This in turn leads to "sedentarist" assumptions about the art's interpretation, (which might be perfectly valid and applicable to art in Western contexts) whereas in reality "a fusion of motion and stasis as potentially coinciding attributes, may serve as a useful metaphor for comprehending both the constant and the dynamic aspects of rock art" (Frederick 2014: 64).

The "sedentarist" approach highlighted by Fredrick is key for rock art research, which is characterised by its physical fixity, and standing in contrast to the kinds of knowledge generated by experimental archaeology. The latter cannot be executed without physical engagement with the physical world in the present day, yet any

method for capturing and further disseminating the “movement objects” produced which does not take account of this is inherently sedentrist. Sedentarism pervades the medium of print and text (consider that reading is rarely an activity carried out while walking). When retro-documentation takes printed form, it reflects the physical constraints and characteristics of that medium. However, it also becomes dependent on the shared epistemological frameworks—the standards and metadata which describe each movement “object”. Standards are crucial to regulate the creation of any dataset and to make it reusable. Yet, as noted above, the very concept of a “standard” implies fixity: the alignment of data to a set of standards *at one particular point in time*. Mapping a landscape according to fixed geographical standards and conventions, such as latitude and longitude, or the colouring of rivers as blue, is one example.

8 Retro-Documentation and Standards

The example of mapping a landscape, like the example of the Ridgeway above, highlights the reliance for retro-documentation of this kind on fixed maps and plans of space. More generally maps, or any other form of fixed diagram, as static frameworks of representation, themselves deal with movement in an imperfect and temporally detached manner. A particular square mile of landscape can be entirely accurately mapped according to such standards, but such a map will only represent the terrain at one fixed point in time. It will not document (for example) the lateral movement of a river as it changes course over centuries, on the emergence of forests over the same period; nor can it reflect the changing perspectives of a user as they traverse a landscape on foot. The instinctive metaphor of “map reading” in fact implicitly links paper maps to the narrative extratemporal fixity of the written word.

Landscape dynamism may be more inferable from static photography, when combined with a map—strengthening the implication introduced above that retro-documentation of movement must, in many case span different forms of media. For example Fig. 3 was taken from the bridge over the River Irving near Birdoswald Roman Fort on Hadrian’s Wall in Northumberland. In the middle distance (marked), is the bridgehead constructed at the time of the Wall, when the river was in a different location. It is clearly visible, and its removal in physical space, as well as time, from the modern day bridge strikes the (physically present) viewer as incongruous. It is a change that can only be appreciated phenomenologically by immediate human presence: by a somatic understanding of the landscape that contains both the ancient and the modern bridge. One can apply the principles set out by Frederick for aboriginal rock art (above) to archaeological landscapes: mobility is key to *their* access, making and maintenance, and “sedentrist” principles of standards, on which data creation, maintenance and curation are based, must be if not rejected, then augmented with critical cross-media frameworks that allow for the subjective vagaries of human enactment and experience of movement. This is what phenomenological archaeologists such as Christopher Tilley have called “societal space” (Tilley 1994: 34). Such



Fig. 3 River Irving in Cumbria (photo: the author). The Roman bridgehead is visible in the middle distance, marked by the red arrow, illustrating the extent of the lateral movement of the river through the landscape since the Roman period

space cannot be understood only through sedentarist documentation and metadata structures; rather there has to be a mechanism for feeding in the embodied and sensory experience of movement as well.

This is an idea which is fundamental to Tilley’s influential book, written in 1994, “A phenomenology of landscape”. As with the examples above, “the digital” has significantly impacted on the phenomenological experience of *information*, as well as the experience of the physical world. The most obvious example of this is the emergence of devices which are able to geolocate in real time: for the first time, it can be argued, the key distinction for this chapter, the distinction between captured movement and documented movement has finally been collapsed by the medium/technology of GPS, which captures movement in three dimensions at the same time as being part of it.

The challenges faced by different disciplines in dealing with movement are therefore very distinct; however, they share one very significant factor. That is that the way in which movement is documented is conditioned by the medium in which that documentation takes place—whether physical, digital or embodied. An example is provided by the case of experimental archaeology highlighted above.

9 Movement and the Digital

The most obvious way in which the digital realm has collapsed the fixity of the map with the somatic engagement of physical presence in, and dynamic movement through, a landscape, is with GPS. Once the preserve of the military and scientific establishments, GPS draws on a constellation of satellites to allow receivers to triangulate their exact position on the earth's surface; and it has emerged as a major feature in the digital age. It is most familiar to public users as a means for allowing mobile devices to draw on georeferenced information in real time, and connect it immediately with other useful forms of information such as routes that the user needs to find, amenities that they wish to use, services that they wish to employ, and so on.

GPS traces can be uploaded to various web services and shared. This essentially allows users to capture their own movement through the environment and save it to a local device or server—which, in the context of this discussion, is a form of retro-documentation. However, as noted above, *digital* retro-documentation allows the capture of movement as a series of static data points, in the form of a latitude and longitude value, rectified according to a trusted geodetic world data standard, and a time stamp. Therefore, while the sedentrist/dynamic tension of the ekphrastic chain connecting the GPS user's movement with the GPS trace's view is not removed, it nonetheless represents a closer, more embodied and more direct relationship between capture, documentation and retro-documentation than any of the methods discussed above, since the data points directly represent the user's actual movement in real time and in real place.

Just as Richard Long challenged notions of sedentrisim in photography with *A Line Made By Walking* (see above), so contemporary artists in the twentieth century have used GPS as a medium to deconstruct the static nature of the digital as a means for encoding embodied human movement using GPS. One notable example is the genre of "GPS art," in which an artist will either use the composite overlay of multiple GPS layers to illustrate things like increased footfall in urban areas, or they use their own movement through a landscape in order to render a 2D, and greatly scaled down image of that journey. One notable example of this genre is the "walking artist" Jeremy Wood, who uses GPS to construct first-person perspectives of particular areas, using GPS traces that only make sense in their entirety, once the walk is complete. In doing so, he uses motion and place to challenge human perceptions and notions of scale, recognising that the "map" produced in fact exists at a scale of 1:1, and is itself a product of phenomenological engagement with the landscape. As Wood himself puts it:

Our personal navigation is evolving from looking up at the stars to looking down from satellites mediated by digital devices held in our palm. The two meridian lines are the edges of maps that don't meet up: between them are places that don't exist. (Wood 2006, quoted in Lauriault 2009: 361).

GPS motion traces are a key feature of the so-called "GeoWeb," the subsection of the Internet which caters explicitly to the standards, practices and infrastructures of geographic data, and which is increasingly used as a guide, mediator and facilitator

of human movement. However, unlike Wood's motion-as-art, most GPS traces on the GeoWeb are uncurated, or at least only partly curated. Numerous platforms for the sharing and use of GPS traces; and a notable feature of most of these is that the only form of structure or organisation is rectification to the same systems of latitude/longitude/timestamp (**ref**). One of the best-known GeoWeb repositories for GPS data is the open mapping platform OpenStreetMap, a user-generated and open source map of the world.² Users can add geographical features to the map, but the site also contains a repository for GPS traces which supports the **.gpx** format. People do so for a variety of reasons, for example, to share details of a walk or a run they have done, a favourite route or path, etc. Sharing captured and retro-documented traces, whether intestinally or unintentionally, can have unintended consequences. One such issue arose in January 2018, when the GPS data company Strava, which provides services to a number of companies dealing in fitness tracking products such as Fitbit, produce a global "Heatmap," providing a composite global picture of anonymized GPS traces generated by athletes using the third-party mobile devices for monitoring speed, heart rate, etc. This led to the internal geography of the US air force base at Kandahar, Afghanistan, being exposed in the form of a very clear set of outlines, composed of the traces left by the base's personnel using fitness trackers as they navigated the base. This led to the US military reviewing its rules on personnel's use of such equipment.³

The collectivization of GPS traces, of the retro-documented movement of multiple actors through a landscape, can thus build up a detailed somatic picture of that landscape, and of human interaction with it. As well as unintended consequences such as those just described, this can also allow us to trace the impact of conscious design decisions. For example, the area of west-Central London between Piccadilly Circus and Oxford Circus was laid out by the architect John Nash in the first two decades of the nineteenth century, one of the first designed parts of London. Nash based his approach on the idea that Regent Street should act as a connector between these two hubs; but also that it should act as a divider, separating the two areas of Mayfair to the west, and Soho to the east. This was a straightforward piece of social engineering: Mayfair was (and is) a highly affluent part of London, the base of high-end residences and businesses, whereas Soho was characterised by tenement-type dwellings and commercial premises. Nash made his methodology of separation plain, stating that his intention was

...a complete separation between the streets occupied by the Nobility and Gentry, and the narrower Streets and meaner houses occupied by mechanics and the trading part of the community ... My purpose was that [Regent street] should cross the eastern entrance to all the streets occupied by the higher classes and to leave out to the east all the bad streets (John Nash, quoted in Johnson 2006: 20).

Thus, the west-facing exits of Regent Street are broad and accessible and facilitate the free flow of pedestrian and vehicular traffic, whereas the east-facing exits are narrow, often one-way and/or pedestrianised, and do not facilitate the free

² See www.openstreetmap.org.

³ See <https://www.wired.com/story/strava-heat-map-military-bases-fitness-trackers-privacy>.

flow of any traffic. This is clearly visible on the relevant area of OpenStreetMap (Fig. 4), where the exits east to Vigin, New Burlington, Maddox and Conduit streets, towards Mayfair, are relatively heavily populated with GPS traces, whereas the east-facing exits are not. Thus, whilst the area's urban configuration is at least substantially informed by eighteenth-century class preoccupation, unstructured GPS retro-documentation allows us to visualise the impact of those preoccupations in the present day urban landscape.

This brings us back to direct motion capture itself. In 2010–12, the author participated in a series of experiments using motion capture to test contemporary human responses to historical environments, notably Iron Age round houses, of the kind known from archaeological excavation to have been widespread in Britain before the Roman invasion (Woolford and Dunn 2014); the project was called *Motion in Place Platform*. In this sense, therefore, we were not undertaking direct experimental reconstruction in the sense illustrated above with the examples of butchery and hand axes. The movements necessary to (re)construct an Iron Age domestic roundhouse were not explored, rather the affordances of motion capture were used to examine the use of the domestic environment *once it had been created*. The aim of the experiment was to see how humans reacted to the physical characteristics of the environment such as the cramped space occasioned by the sloping of the roof at the edges, and the obstruction caused by the inner ring of posts; and also sensory aspects of the environment such as the dark (experimental archaeology has established that round houses could not have had windows), the presence of smoke from a central fire, and the acoustic compression. To one not familiar with such a space, these factors are disorientating and unsettling. The experiment sought to establish how people who were familiar with the space contrasted with those who were not while carrying out



Fig. 4 GPS traces from OpenStreetMap (OSM contributors). The dominant flows of user traffic north and south along Regent Street and towards Piccadilly Circus clearly show up, accentuating pedestrian activity towards Mayfair in the west, and limiting it in the direction of Soho to the east

basic domestic tasks such as using a quern stone and sweeping. The motion traces produced through gyroscopic motion capture analysed how those unfamiliar oriented themselves in contrast to those who were familiar, as well as the fluid, ergonomic efficiency of the way in which an expert used a quern stone, versus, one who was not (see Woolford and Dunn 2014, Figure 5).

The outcomes of the experiment itself have been published elsewhere (Woolford and Dunn, 2013; Woolford and Dunn 2014). However, the discussion above allows us to illustrate the digital objects produced by MiPP into the context of the ekphrastic chain, and as examples of elements of retro-documentation. At some point in the first or second century BCE an unidentified Iron Age inhabitant of Britain undertook the use of a quern stone and a broom in a round house dwelling. The fact that they did so is inferred from archaeological evidence; but the embodied movements themselves are transitory and lost. 2000+ years later, a round house reflecting the one in which they undertook these tasks is reconstructed, experimentally reproducing the environment. Those tasks are undertaken again—it is inappropriate to use the term “re-enactment,” as the specific original enacted task is unknown—and remediated using direct capture. The motion, ultimately sourced to routine activities in distant antiquity is essentially reconstructed and re-understood in a different time, and by a different audience.

10 Conclusion

This chapter has traced a trajectory from the very broad scale of historical events (Emma Willard’s map of Empires, Minard’s map the Napoleonic campaign), to the scale of individual people, through media from paper, to the digital to the landscape itself. It has been shown that the concept of retro-documentation of movement is a key element for historical understanding of events such as those described in these examples. It has also been shown that as digital methods for recording and analysing movement, such as GPS and GIS are introduced, it becomes easier to retro-document the movement of individuals, but that the “ekphrastic chain” linking the original movement to its documentation remains key to problematizing movement embodied in the past and re-created, and retro-documented, in the present.

The MiPP experiment provides an example of how direct, immersive interaction with the environment can be retro-documented through a combined process of direct engagement, digital capture and archaeological interpretation. It fits into a far broader landscape of how “the digital” has both introduced new challenges of understanding movement in the humanities, but also into the possibilities it offers. Direct observation such as gyroscopic motion capture, or even GPS, does not remove the documentary links in the ekphrastic chain, but rather it illustrates that those links should be regarded as effective, possibly non-textual and experimental. It should that motion in the past can be investigated, just as any other archaeological “object” can be; but just as archaeology has had to re-think its approaches to object analysis in the light of ideas such as processualism, uniformitarianism and experimentalism; so it has an

opportunity to re-think its approaches to motion in the light what digital capture has to offer. This chapter has sought to offer the beginnings of a framework, in the form of retro-documentation, for doing so.

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