The Camera 'at the trowel's edge': Personal Video Recording in Archaeological Research

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Abstract

Video recording is increasingly becoming a favourable medium in archaeological research, particularly as an unconventional documentation tool that captures the elusive processes of on-going interpretation in an audio-visual format. Our research forms part of the Personal Architectonics Through INteraction with Artefacts (PATINA) project, a project that aims to revolutionise the design of technologies for supporting research, by emphasising the primacy of the research material. Archaeological fieldwork is one of the research environments being studied by the project, and one of our primary concerns was to observe and record current research practices in the wild, and to examine the influence of new technologies on those practices. This research brings together well established and advanced observation techniques used in social sciences and computing fields such as Human Computer Interaction with archaeological research and presents the deployment of an off-the-shelf wearable camcorder as a recording interface in archaeological fieldwork. The paper discusses the user evaluation methodology and the results, while addressing long standing and timely theoretical discussions on the role of video recording in archaeological research.

Keywords: Personal Video Recording (PVR); user evaluation; fieldwork documentation; reflexive archaeology; archaeological method

Introduction

The rapid developments in Information and Communication Technologies (ICT) have not only shaped our knowledge-making processes about the past but have also offered new affordances to engage critically with timely discussions in the discipline of archaeology. The latter, has witnessed both methodological and theoretical shifts by the integration of certain technologies in various stages of research, as is the case with the use of video recording. The rapid developments in digital videography and the novel techniques for capturing, handling and sharing audio-visual outputs create a constant demand for assessing their impact on well-established principles of the discipline but at the same time they offer new insights and affordances for revisiting our research practices.

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This article is concerned with a critical evaluation of wearable digital cameras used in archaeological fieldwork. It presents the findings of a research study which was initiated in the context of the PATINA, a RCUK Digital Economy funded project, aimed to explore how novel wearable technologies may impact research practises and the kind of affordances they offer in transforming the interactions occurring between a researcher and the primary research material and/or environment as well as between researchers themselves. In order to start thinking about those questions and informing the design of novel technologies in the context of archaeology, it was essential to implement a study that would offer high resolution observations about certain aspects of archaeological fieldwork. For the purpose of documenting interpretation processes in archaeological fieldwork in the wild, where the actual activity can be observed convincingly (Hutchins 1995; Lahlou 2011), we ran a study in collaboration with two archaeological research projects, at the sites of Portus, Italy and Çatalhöyük, Turkey. During this study, archaeologists were provided with lightweight and wearable recording devices to use while they performed their daily routine at fieldwork. This way we wished to move away from staged and third party recordings and explore further what might be the value of capturing the interpretive process as it occurs from a personal perspective of each archaeologist-user and revisiting the temporal, spatial, experiential, and spontaneous context of an interpretation.

Drawing from previous work on the role of video in archaeology (Brill 2000; Clack & Brittain 2007; Hanson & Rahtz 1988; Hodder 1995; Morgan 2012; Stevanović 2000; Witmore 2004), the purpose of this study is twofold; first, to explore further videography in relation to the aforementioned contexts of archaeological interpretation, by introducing the Personal Video Recording (PVR) approach, and second to conduct a user evaluation of the personal recording and video management technologies that were employed. Thus, a critical part of this study involved the assessment of this technology and its impact in archaeological fieldwork. We were interested in the behavioural responses of users/team members towards the technology itself and wished to find out if there were any changes introduced to the interactions between members of the archaeological projects and between archaeologists and their primary research material and, if so, what kind of changes we might identify. In this case, the use of technology is not intended to be a means to monitor archaeologists' behaviour - although this unavoidable aspect of the study is further explored in our analysis – but rather to provide an easy way to prompt memories of important discussions or on-going interpretations and to promote collaboration focused around these interpretative mementos. In addition to function as a memory aid the videos also provide a documentation that captures spatial, sensuous and bodily aspects of fieldwork that are normally not easily recorded, and thus allow the excavator to revisit and others to visit the circumstances of a finding. Additionally there is a temporal aspect, in which not only the sequence but also the pace of excavation becomes visible. This way the videos form a unique and complementary kind of documentation.

This study allows a comparison between a situation when a third party is managing the camera with self-administered cameras (Çatalhöyük), and introduces PVR via wearable cameras in a case where video has not been used as a documentation method before (Portus). Based on our findings we argue that personal and decentralised workflows of video recording are more compatible with the notion of reflexivity in archaeological interpretation and ease any concerns raised by third party video production. In this article we also delineate different styles of on-camera narratives, including non-textual and, discuss how the medium itself creates new research questions about the audience of those narratives. Finally, based on the conducted evaluation, the paper provides important insights to improve PVR for the purposes of archaeological research.

Background

The history of videography attests to a long standing presence of film in the cultural heritage sector, dating back as early as 1931 (Morgan 2012: 78), and indicates the significant role it has played in the documentation and dissemination of archaeological research. Leaving aside the many professional films and TV series that have been produced to promote the discoveries of archaeological expeditions and the issues archaeologists face in the process of unveiling the past, there has been a remarkable diversity in the way that video recording has been appropriated for the different demands of the discipline such as visual and oral documentation, experiential, sensory and reflexive archaeology and for pedagogical material (Clack & Brittain 2007: 57). Film has in this way become a part of the field of ethnographical study of archaeological practice (Edgeworth 2006). There have been a few attempts to classify archaeological film in genres according to their purpose, the audience or the subject matter they address (Beale & Healy 1975; Kraemer 1958; Laude 1970). However, Morgan provided a new categorisation that incorporates the "free form" video captures enabled by digital videography (Morgan 2012:83); namely she classifies archaeological videos into the categories of "expository", "direct testimonial", "impressionistic", and "phenomenological", while admitting that a video can include more than one theme (Morgan 2012:83). The advent of digital videography in the late 90s and its adoption in fieldwork documentation and ethnographic work at cultural heritage sites (Rakić & Chambers 2009) during the 00s, has enabled more cultural heritage professionals to experiment with video and has thus elevated video recording as a promising research practice in the discipline, favoured among others by scholars who are open to reflexive methodologies[5]. At the core of what digital video offers is the possibility of multi-vocality, interactivity and flexibility in the making of interpretation about the past (Brill 2000; Hodder 2000; Witmore 2004). Due to the combination of image and sound and the capture of situated and spontaneous bodily and oral expressions around the subject matter, video has been considered as an auspicious medium for the discipline and more favourable than other documentation methods, which are "dominated by handed-down scientific codes" (Brill 2000:230).

At the research project of Çatalhöyük, one can witness in considerable density these technological and theoretical shifts in the field of archaeology; and it is often difficult to discern whether it was the technology or the theory driving the developments. Since 1995, video recording has been used to document "group discussion in trenches, individual accounts of excavation progress and laboratory work" (Hodder 1997) and has since been the subject of much debate and discussion (e.g. Brill 2000; Stevanović 2000; Chadwick 2003). In the past seasons[6] such video recordings were implemented via a dedicated site videographer – whether a professional filmmaker or an archaeologist specialised in media – who captured the on-going interpretations of excavators and specialists. Those videos were filmed when the excavation of an area reached the same phase; after tours of the specialists of the site, capturing the excavator summarizing the discussions; when something important was

[5] Here, we use the term reflexive for methodologies that recognize that archaeological interpretations are historical and conditional, and enable systematisation and documentation of processes of interpretation and knowledge creation, as it has been used in the Çatalhöyük Research Project (Hodder 1997, 1999, 2000, 2003). Other attempts at developing reflexive field methods took place in various other projects around the same time as at Çatalhöyük started or shortly thereafter (e.g. Andrews et al, 2000; Bender et al 2007; Lindhe et al 2001; see also Berggren 2009). For an indicative but not complete bibliography on reflexive archaeology see Potter 1991; Hodder 2003; Berggren 2014 and Londono 2014.

[6] The Çatalhöyük Research Project has implemented video recording as one of the steps towards a reflexive method (Hodder 2000) since the beginning of the project. The film clips are available on the website of the project, however at the moment only films made between 2004 and 2008 are accessible. The number of videos made per season has varied and the numbers are lower from study season years, when only limited excavation was taking place.

discovered and at the end of the season. The film clips are called “phase” or “priority” videos as well as “end of season videos”. Overall, the video cameras employed for filming tended to be stationary and the resulting recordings appeared somewhat staged. They do not generally capture the actual processes of excavation, the conversations between excavators or the archaeological materials as they occur. During the first study seasons of the project the team members got together and watched the videos during group discussions, in an effort to contextualize their analysis. This was not repeated during the following study seasons as the process was considered ineffective in the way it was implemented and conducted. Also, specialists seeking detailed information on certain contexts have found the search function of the video clips on the web site of the project insufficient. Essentially, the large volumes of video are often difficult to manage, search and parse for important information, and, unlike other types of data, the video archive is still left under-inspected and stored independently of the interpretative process. Despite the considerable efforts that have been recently put to handle such data and more importantly to make them easily accessible to the team members (Tringham et al. 2012), solutions that will bring video recording to mainstream adoption in archaeological research is still far from realisation. Perhaps, one of the reasons for this lies in the fact that video processing and annotating have been considered as post-fieldwork tasks, often conducted by designated media specialists and, so far, other modes of on-site selective capturing and annotating have not been considered.

It is worth noting that in the long history of archaeology, there have been quite a few mentions of disquiet about the appropriation - intentionally or not - of visual media used in archaeological research as mechanisms of control, surveillance and power structuring (Berggren & Hodder 2003; Berggren 2009, Chadha 2002). More recent documentation processes, from on-site videography and mandatory reflexive diaries to on-line published photos and blogs produced by project members or appointed media experts, alongside the rapid sharing mechanisms enabled in the age of participatory web, raise further concerns of exposure. In the case of Çatalhöyük, the early adoption of videography in on-site documentation apart from opening up new horizons for archaeological research practices, it also brought about some of the first criticisms of the medium within the project. As Morgan puts it “This feeling of being watched was especially true when videographers or people recording sound would come on site without warning. It was disconcerting to look up and realize that you were being filmed - what was I saying?...The availability of inexpensive video tape allowed a more casual use of filming around the site, and the zoom lenses and directional microphones allowed videographers a false proximity to excavators who may or may not be aware that their actions and conversation were being captured and subsequently used without their knowledge or permission” (Morgan 2012:90). The above concerns a situation when filming and sound recording were performed by film teams and research teams that were invited to carry out their tasks on site, but were not a part of the Catalhöyuk Research Project. However, the filming taking place within the routine of the recording system of the project (in which the excavators were not filmed unknowingly) has also been criticised. Issues with regards to the intrusive nature of videography as conducted previously at Çatalhöyük with media expert personnel (Chadwick 2003:103) and a feeling of pointlessness have been mentioned (Morgan 2012:90). The above concerns were of significant importance to our study and as it becomes evident from our analysis below, the personal recording approach attempts to overcome the surveillance critique in favour of the positive aspects of video documentation.

Recent developments in videography, whose late products are more recently available and affordable for a mainstream adoption, seem to come closer to Vannevar Bush’s vision in the 40’s of the future researcher: the

image of a scientist who captures his on-going experiments with a small camera fitted on his forehead (Bush 2003). This early vision that, while a scientist would be fully engaged and interacting with the research material, an observation device would later allow him/her to engage in the revision and interpretation of the research finds coincides with certain aspects of reflexive methodologies and Ian Hodder's vision of a complete "hermeneutic process" in archaeology aided by video recording devices (Hodder 1995). After Steve Mann's first wearable devices which were used for life-logging (Mann 1998; Mann et al. 2005), today wearable camcorders have exited labs and have dynamically entered the mainstream as means to record recreational activities. Corresponding to Bush's and Hodder's aforementioned visions, in the study discussed in this paper, we deployed off-the-shelf, wearable camcorders as the appropriate probes for seamlessly capturing personal interpretations at the "trowel's edge" (Conolly 2000; Hodder 1997); at the exact moment when the interaction of the archaeologist with the primary research material occurs. While "reflexivity indeed takes time and attention, which would disturb the subject in the flow of action" (Lahlou 2011), with the aid of personal, wearable and unobtrusive camcorders, such interactions can be revisited in detail and reflected upon at a later stage without interrupting the flow of the task at hand. Thus, it could be argued that the adoption of personal recording in archaeological fieldwork, where the camera becomes a personal interface for the archaeologist, rather than a recording device operated by a third party observer, in theory creates an interesting ground for exploring further reflexive archaeology. Even in cases where additional post excavation work is not particularly welcome (e.g. in commercial units), we suggest that such recordings could offer a kind of retroactive confirmation of decisions made at the trowel's edge and a kind of audio-visual diaries for future reference. Certain technological strands that could tailor personal recordings for archaeology and, consider both time and effort management in the workflow are also addressed in this article.

Description of deployment and case studies

The data collection for this study occurred during a number of field sessions from 2011-2014. The first study was carried out at the archaeological site of Portus, a maritime port which served Imperial Rome between the mid-1st century AD and the 6th century AD. The Portus Project is a long-standing research collaboration between the University of Southampton, the British School at Rome, the University of Cambridge and the Soprintendenza Speciale per i Beni Archeologici di Roma. The study took place during the excavations at the south-east of the Palazzo Imperiale at the centre of the port, under the direction of Professor Simon Keay. The second study took place at the East and West Mound excavations of the Çatalhöyük Research Project. The Neolithic site of Çatalhöyük, is one of the first known urban centres of the world (7400BC) and since 2012 has been listed as a UNESCO World Heritage Site. The excavations here directed by Professor Ian Hodder have developed some of the most influential theoretical, methodological and technological developments in the field of archaeology.

Our main concern in recruiting participants for the user-evaluation study was to ensure the participation of members who play different roles in the team, ranging from students and experienced excavators to field and lab

directors (see table 1)[7]. Other important factors were the availability and consent of the selected people to participate in this task as well as the different levels of experience with video recording and revisiting processes. Additionally, the participants should ideally work in a team or at least near other members of the excavation and not alone or at an isolated place of the site, in order to capture as much of the interactions taking place between members of the excavation. The requirement of English speaking participants for facilitating video transcription and data analysis played a significant role in selecting the participants for this study. Both Portus and Çatalhöyük involve multi-national teams. In total, 17 archaeologists took part in this study as users of the personal camcorders which they used minimum from 1 day to maximum 5 days. Additionally, the majority of each fieldwork's members gave their consent to be recorded and interviewed while, three more archaeologists who usually work in the laboratories had the opportunity to watch some of the captured video segments and provide their feedback.

On the first day of the deployment, each archaeological team was briefly informed of the purpose of the study and was introduced to the device and the different modes of recording. The first device chosen was an off-the-shelf device called Looxcie 2, a small wearable and lightweight video camera mounted over the ear which continuously records everything the user sees and hears. With one touch of a button the user can record the past 30 seconds (via a loop recording mechanism that can store up to 30 seconds of the captured footage), a functionality that instantly creates small separate clips, called highlights. This allows the capture of interactions in retrospect when they were not anticipated, and provides a tool for instant segmentation of the raw footage on-site. The users can later access both the raw footage and the separate short clips generated by the highlight feature. There are also two quality settings of recording (320p/15fps and 480p/30fps) which determine the battery life and storage capacity. The mounting position of the device close to eye-level, the miniature design which ensures that the device will be as subtle as possible for the user and other participants, as well as the adequate visual and audio features were important factors for choosing the particular recording device (fig.1-2).

The users were instructed how to operate the device to ensure recording and how to switch between the continuous recording and the instant clip functionality. They were encouraged to use the latter when they felt that there was a need to highlight events or discussions during the use of the device. This process was repeated each time a new participant took over. It was also decided that members would not be assigned a specific task based on a specifically designed experiment, but rather that they would carry out their activities entirely as normal. This strategy was chosen for two main reasons:

a. Fieldwork constraints: the excavation projects have important deadlines to meet and individuals have specific tasks to achieve, therefore it is important not to disrupt the participants' working routine. This point coincides with the nature of study we wished to conduct, which is influenced by certain observation methodologies in the fields of Psychology [see Subject Evidence-Based Ethnography (SEBE)], Anthropology and Human Computer Interaction. Particularly in SEBE and ethnomethodology using video recordings, it is important to capture naturalistic activities from a personal perspective and have the subject revisit his/her activities as a means of introspection (Lahlou 2009, 2011; Nosulenko & Samoylenko 2009; Suchman 2007). This process ensures that the subject will not interrupt – at least not to a certain degree – the actual flow of the

[7] . It should be noted here that Table 1 provides useful data concerning the evaluation process but those data are provided only for participants who used the wearable cameras and Synote (see Evaluation Procedures) and not the entirety of colleagues who were involved in this study. Since we engaged in a qualitative analysis of the obtained data, and the overall number of participants to this study is not large enough for statistically significant results, we opted out from writing them up in a quantitative manner.

Fig. 1-2 Participants using the wearable camera at fieldwork

activity and the respective mental processes in order to perform introspection.

b. Intuitive use of technology: at this stage we opted for making the recording device available and observing how archaeologists would use it naturally, in an uncontrolled manner. Consequently, we also deliberately chose not to be present on-site throughout the day in order to avoid influencing the behaviour of the users and the rest of the participants. However, we acknowledge that influencing the behaviour of the subject, as it applies with all commonly used observation techniques, was unavoidable since the subject has the awareness – to whatever degree – of being observed (Lahlou 2011).

Evaluation Procedures

The evaluation procedure involved on-site limited observations synchronous to the deployment, semi-structured interviews with users and post deployment analyses of the captured footage. In terms of the first evaluation method, the study conductor remained on-site for approximately one hour per day in order to instruct the users individually on how to use the device and observe users in their first interactions with the device. Notes and photos were employed to document what they did with the technology and what sort of information they were eager to capture. Each day participants were given the video segments they recorded and were encouraged to review them in the dig houses during evening hours and keep short notes on whether these recordings were useful and how. On three occasions, the participants reviewed the captured footage after two, six, and twelve months respectively. This way, we ensured that our collected feedback would include both short and long term revisiting processes. In accordance with our ethical procedures, the process of data collection involved the participants choosing to give us the data they had captured since we wanted the excavators to feel in control of opting out of giving us particular data to ease any privacy concerns.

One of the main lessons learnt from the first year's study was that it was difficult to engage non-users that appeared in the captured footage in the study and consequently to provide them with access and control over the outputs. For this reason, in the second year of our study, we provided a chart with the names of all excavation members and asked the users to tag next to the names of their colleagues in which clips they appear each day of the study. This way, we provided for all members of the excavation an analogue mechanism of control and awareness of the captured footage. In practice, members of the team who saw their names tagged on the chart could access the specific videos archived in Synote, a video retrieval, annotation and display software (see section below) and contribute their own observations as well as give their consent or not for specific videos to be available for the project members (fig. 3-4).

Fig. 3-4 The evaluation site at Portus. On the left, participants access, watch and annotate their videos before the interview. On the right a participant makes use of the chart provided for raising the awareness of other team members participating in the captured videos.

Additionally, interviews of approximately 30-45 minutes were conducted at a time that caused minimum disruption to the everyday workflow of archaeologists who agreed to participate in this study. The interviews were conducted in a semi-structured manner which was achieved by posing certain open-ended questions to

ensure variety in responses and facilitate a constructive dialogue between interviewer and interviewee (Gaver et al. 2004: 56). Participants had the opportunity to comment on their experience of using the personal recording device and on their reflection after watching their captured footage. They were also confronted with certain moments they chose to record and were prompted to discuss the reasons for choosing to record, the content and interactions taking place in specific scenes; the method of confronting subjects with certain behaviours observed in the captured footage ensures that the interviewer understands and interprets correctly what she/he observes (Lahlou 2011).

Finally, video analysis was used to decode certain patterns of interaction between users and the device, team members and research practices. The video recordings provided the required high resolution observations both for conducting the evaluation of the use of the medium as well as for exploring the actual archaeological processes by proxy. The methodology of this evaluation is based on interaction analysis used in ethnographic techniques in similar HCI studies (Heath et al. 2010) "that emphasizes the ways that the team themselves understood and interpreted one another's interactions" (Knibbe et al. 2014). The selected scenes were also, transcribed using Jeffersonian notation and subjected to repeated viewing. A significant corpus of data was disseminated among experts of video analysis and narrative within the PATINA project.

Evaluation of Synote in Archaeology: a video annotation and management software

In order to tackle the issue of handling the generated video data, we used Synote, a software created by the MACFoB (Multimedia Annotation and Community Folksonomy Building) project, a JISC funded project carried out at Learning Societies Lab, School of Electronics and Computer Science, University of Southampton. Synote is a web-based application that enables the creation of synchronised bookmarks, the Synmarks, which can contain notes and tags synchronised with audio or video recordings and transcripts, and can be used to retrieve and replay segments of the recordings. The particular application allows users to add notes and tags to several parts of a single recording (unlike other systems that allow such operations to the whole file) and thus, searching and parsing of video segments and the accompanying information became less of a trivial task.

Recognising the potential of Synote for handling PVR in archaeology we ran a small scale evaluation with the help of some participants of the main study to evaluate the application's efficiency in archaeological research. The Synote team, provided us with a standalone version of the application, suitable for running at the excavation house and accessible from a variety of personal devices such as laptops (Mac OS and Windows environments) and tablets (Android and iOS platforms). Participants were given a brief overview of the application and its affordances and watched certain video recordings that either they or their colleagues created, with their personal or provided by the project tablets and laptops. Controls on the player were used to Play, Pause, Stop the media and control the volume, and the size as well as the viewing mode (full-screen, embedded screen to the Synote interface) could change to the user's preferences (fig. 5-6). The application enabled users to perform, simultaneous to the viewing, annotations in the parts where they felt a comment was required. This was achieved by creating a bookmark (Synmark), at any part of the video recording which automatically kept the time information while other information (like title, end time, comments and tags) could be manually or semi-automatically entered by the user (fig. 7).

Fig. 5-6 Instances of different viewing modes from the evaluation.

Fig.7 Instance of a user annotating a video.

Finally, the software offered a collaborative platform where multiple users could watch and annotate simultaneously the same video. Other utilities of the software such as creating and using transcripts, editing video recordings and linking to social media were available but not used during the study. The video annotation process took each participant approximately from thirty minutes to one hour to complete and was recorded by wearable devices to provide high resolution observations for the evaluation. The results of this evaluation will be properly utilised and disseminated by our colleagues at Learning Societies Lab; however, we will mention in our analysis some observations relevant to our study, where appropriate.

Using the recording device: Affordances, Outputs and Contexts of Use

From the observations and interviews we gathered a series of practical points about the use of the Looxcie camcorder on-site. Participants reported that the device was easy to operate and robust enough considering the challenging environment in which it was tested, albeit some of them thought that a waterproof device would be more suitable for fieldwork. The personal recording devices were generally used to capture either the actual physical interactions of the users with the primary research material or conversations with their colleagues. The hands free recording enabled archaeologists to record highlights of their on-going interpretation while being fully engaged in the process of excavating, in conversations and in performing other types of documentation. The fact that no additional staff members were required for recording and that the excavator's perspective was enabled by the wearable device was assessed very positively. Usually on-site video and camera recordings represent someone else's perspective and not the excavator's. The wearable device records from a position close to the eyes of the user, providing an additional layer to the recordings: the intuitive perception of the working environment as the archaeologist engages with it. Thus, it could be argued that the use of this technology for documentation brings "interpretation at the trowel's edge" (Hodder 1997) to a position where it can be captured (or at least sampled), then shared, and afterwards enriched through commentary and remixing. The embedded microphone enables high quality captures of speech and sounds generated by the user while close range conversations (2-4 meters away from the device) are adequately recorded[8], ensuring that "conversations that matter" to the archaeological record will be documented without any additional infrastructure as with third party recording (Goodwin 2006: 52). Additionally, users favoured the fact that they decided for themselves which moments were to be recorded, the length of the recordings and that eventually they could have control over the outputs, a fact which has not been possible before due to the centralised way of video recording and processing by media experts.

Users also reported the benefits from the reviewing process which usually took place during the evening work at the dig houses and in three occasions after two, six and twelve months respectively. The archaeologists had the opportunity to assess their on-going interpretation by retracing their working processes as they occurred on-site while fully engaged with the archaeological material. Even though the filming was also a result of

[8] The comprehensibility of such recorded conversations may depend on many variables such as the ambient noise, the volume, articulation of speech and the pronunciation of English. Here from our experience we provide an average estimation of what we can expect from the personal camera recorders.

certain decisions and choices of when and what to film, the video documentation offered them an overall view of their working environment and the progress of their discussions around certain features, a fact which brought about an arguable comparison between the specific affordances of personal video documentation and the fragmentation of the official record, where the films can fill in some of the gaps of that record. Although, none of the participants thought it would be a good idea to replace other conventional documentation methods with video recording, many recognised the reduction of time and energy spent on-site with the use of the latter. The issue of time management on-site was also discussed in relation to a habit that admittedly often occurs at fieldwork, that of keeping draft notes and filling in the recording sheets later on in the day at best of circumstances. In doing this, many draft notes get lost before entered on the official record or are not detailed or accurate enough.

Participants were also asked about whether there was any value in revisiting the videos they had captured. Most of the participants recognised the benefits of having a record of their first thoughts, the moments of decision making, the actual excavation process, and the sequence of actions that took place, so that when they revisited their daily work (for instance before writing a report) they have an audio-visual cue and thus, a clearer idea of the reasoning behind certain decisions. Besides, any attempt to revisit and reflect "subjectively" on previous experience without having an actual record of it, becomes a trivial and questionable task (Lahlou 2011). P#7 characteristically reported that she found the video documentation very useful because she was able to convince her supervisor - who was not present all the time – "about the number of plaster layers that were there before removing them". She also mentioned that she had previously experienced similar cases when a more authoritative person – who was not constantly present during a phase of the excavation-, interpreted the development of the excavation differently than her and she had ended up dismissing her own judgement.

In another case, the transient nature of certain materials gave particular prominence to personal recording during excavation. As P#12 notes "because the material we examine is at best transient as they get uncovered in the field, to be able *to record it in such a complete way as this camera affords is very important to us…the recording is very important for our interpretation because once you've moved for instance carbonised wood in the lab it's already fragmented. The important moment is whe*n it comes out from *the soil; that's when at least* seventy percent of our interpretation is fixed. Then the recorded video works as a memory enhancement, because no matter how many measurements you take or notes and photos you make they are still generated post factum". Perhaps, the ephemeral nature of archaeological spaces will always present "lost opportunities for capturing" and documenting associations within those spaces (Knibbe et al. 2014) but according to participants' views, personal video recordings seem to contribute significantly towards reducing those opportunities.

Additionally, participants who made use of Synote gave interesting feedback in the ways that the system facilitated retrieving, viewing and adding contextual information to an otherwise vast and disorganised set of data. Overall, participants found that Synote provided a user-friendly environment to easily parse larger video recordings and add contextual information where necessary. There was almost no need for previous experience of the system for users to start using it and this fact was rated highly by the users. Another interesting aspect of revisiting the personal captured footage via Synote was the fact that participants were able to share video segments with other members of the team as well as view the captured footage collaboratively and simultaneously from different devices, a fact which prompted discussions and enabled the exchange of views and interpretations. In those discussions, archaeological deposits and on-going interpretations were scrutinised

within a continuum of time and space; past (the on-site processes) with present (e.g. post excavation synthesis) and physical (finds processed in the labs) with digital (the excavation process that revealed them). However, participants commented that the system cannot be used independently of the any existing archaeological database as linked data are of prime importance in archaeological research. The recent experiences at Çatalhöyük of adopting video recordings as a formal documentation process have indicated that any information stored independently from the project's main database is less likely to be used by archaeologists.

Certain issues with the use of the device were also identified by the evaluation and mainly concerned the mounting mode and the technical characteristics of the device. It was reported by the majority of participants that the ear mounted device appeared to be a bit wobbly and at times irritating due a beeping noise that the device made each time the 30 seconds loop started. As a result, some users preferred to wear it only when they actually used it or used it by turning it on and off. Another important issue had to do with the frame's edge. The perception captured by the ear position and the limitations of the camera frame (Diagonal Field of View FOV is 65.5˚) often resulted in off-set captures. However, the more users got acquainted and experienced with the device as an interface, the better use they made of it, as was ascertained by the interviews and the video analysis. Second and third day videos captured by the same person present better coverage of the things that the excavator-user actually sees and talks about. It is worth noting, that users were able to adjust the orientation of their camera via the live view stream modality of the provided paired mobile devices afforded by the mobile looxcie application. In practice however, once users mounted their camera and calibrated their view they rarely used the application and preferred to operate the camera manually.

Concerning the quality and general efficiency of the data captured via Looxcie 2, participants rated the high resolution recording mode as more suitable for this type of documentation but at the same time they thought it lacked in terms of capturing fine details that are of great importance in archaeological documentation such as colour. As it was characteristically reported by P #11 "Although, my device was set in the high resolution capture mode and you could see some differences in the soil, the colours were not as I expected them to b*e*…. In the parts where I was excavating there was a variety of colours exposed in the soil like very sandy orange materials and burgundy clays and I tried to identify them in the captured video but they were not very clearly distinguished*"*. At the same time the participant found video data more useful for revisiting "in a visual manner the spatial distribution of raw fill (soil and scrap materials) in relation to the actual features (building materials) of spaces*"*. Following on from first year's evaluations, in the second year we tested Looxcie High Definition (HD) and Go Pro Hero3 devices to address the issues of image quality and field of view. The improved video quality (1080p at 30fps for both Looxcie HD and GoPro cameras) was evaluated very positively for capturing fine colour hues and details of objects while the Ultra Wide setting of GoPro sifted out any previously reported issues with the narrow and at times off set captured field of view. It was ascertained however, that GoPro cameras are not suitable for high quality audio recording in its present form, as the protective case – which was necessary for the protection of the device in the fieldwork environment – blocked sound input.

Another important affordance of the device was the aforementioned highlight feature. In the beginning of the study the users were asked to keep the device continuously recording and to use the 30 second highlights as much as possible in order to generate small and manageable video segments of the important things that occurred during their work. In both case studies less than half of the participants made use of this modality. The

feedback from the participant (P #1) who revisited the clips after six months was that "the 30sec clips had cut a captured conversation too much to be actually useful in identifying the overall frame of the discussion". In order to be able to contextualise it the participant had to watch the actual raw footage and skip the lengthy parts where he was just using the wheel barrow or troweling. The conversation was about whether to leave something in situ on the ground or take it out which perhaps, is one of the most common dilemmas occurring during an excavation. The clip alone however, was insufficient in providing the context of what it was they were talking about. Another issue with the highlight functionality is found in the spontaneous estimate of what is worth recording each time. For instance P#2 mentions that in one of the highlighted conversations he talks with one of his colleagues about the correct name of a certain geological component which was commonly found in the excavated Roman concrete. The participant thought at the time that it would be valuable to highlight this conversation, but in retrospect found that this information was not really useful anymore. As the participant comments "C and I talking about geology. Black tufa or black pozzolana; this is a difference that I am since so familiar with, that looking back does*n't give me much further insight, except to remind me that I was once so naïve*". Throughout the excavation season the geological component subsequently appeared many times after the conversation and the participant had repeatedly recorded the information in the context sheets until gradually it became part of his/her knowledge armoury; in other words, the information on the video became redundant. This means that certain information captured on video might not have value as materials for the interpretation just at hand, but still maintain a value for self-reflection, as the process of learning may become visible to the excavator. The general process of creating an understanding for a site is thus documented. In addition, it could be argued that the audio-visual information whose format is richer than text and thus also obtains its didactic value for novice members of an excavation project.

At Çatalhöyük after the first two days, when the team members had already experienced the use or the function of the device in their daily routine, a certain 'stance' towards the process started to emerge. Although, participants acknowledged that the highlight functionality was useful as it provided the opportunity to do some in situ refinement of data, there was almost no use of it. According to their assessment the thirty second clip was not really long enough to capture something useful about their work and as P#9 mentions "…if you feel that you have to operate it in some way then you are starting to concentrate on that task rather than your usual way of working on-site". Eventually, the participants at Çatalhöyük took absolute control of their device by switching it on and off; a fact which negated the benefit of a possible serendipitous capture discussed above but at the same time it gave more control to users. Perhaps, a future purpose built camera for archaeological fieldwork could be designed so that the instant clip's activation and length would be controlled by the user through an intuitive user interaction modality. Gesture recognition and gesture-based systems have been recognised as a promising field in Human-Computer Interaction research that changes the ways that humans can communicate with machines (see for example Camurri et al. 2004; Caridakis et al. 2009). Such systems could utilise the rich gestural communication culture found in such physical research environments, as in archaeological fieldwork, to provide more control to users in capturing small and hence, more manageable instances of their work without distracting them from their main research focus and the interactions entailed in it. In the following section we will elaborate on our observations on the existing types of gestural interaction found in archaeological fieldwork.

Types of On Camera Narrative about Things

The types of video recorded by archaeologists in the study corresponded broadly to two categories of archaeological video identified by Morgan: the "direct testimonial" – a type of ekphrasis, performed on video by the archaeologist while "embedded in the landscape" of the excavation (Morgan 2012: 86), and the "phenomenological" – a type of video, which aims to give "the viewer the gaze of an archaeologis. Filmed at eye-level, the video attempts to convey the sense of landscape and place" (2012: 88). However the different ways in which participants conducted video documentation can be further analysed and distinguished. The most common use of the technology chosen by participants was to record conversations they had with their colleagues about certain aspects of their work, as they were engaged in it. Some participants prioritised recording at certain moments when they decided it was worth keeping a note. A third type of recording encountered involves the actual process of excavation with no oral comments. As P#9 explains *"I didn't actually talk to myself about what I was doing…I was more interested in keeping a visual rec*ord of my *excavation processes".*

Common to all three of these approaches was the recording of continuous temporal data in an embodied form, introducing into the archaeological record details of the sequence of excavation, the archaeological features, their interpretation, and the involvement of other individuals. We might consider these recordings to be narratives: in that they constitute documents of lived experience and also in that the phenomena and events that they record are organised and interpreted by the archaeologist-user and his or her interlocutors, who act as the narrators of the narrative. At the same time we can also consider them as arguments, since they also seek to establish facts, truths and evidence, as part of the process of interpretation. Key methods of narration and argument adopted by the archaeologist-users were gesture, movement, camera positioning, oral commentary and discussion in the form of conversations between excavators. We elaborate further on the use of gesture, movement, camera positioning and oral commentary below, while the recording of conversations is discussed in the next section.

The hand gestures captured by the wearable camera provide a rich account of the interactions taking place between excavators when communicating their ideas to peers or between excavators and their research material. Hand gestures, as all bodily gestures, are movements conveying information (Kendon 1988, 1994, 2004); gestures act as part of our communicative and expressive armoury in our engagements with the material world, other intellectual beings and abstract ideas (Streeck 2009), and it is considered to form a symbolic system that stands between and connects speech and thought production (Calbris 2011). Several frameworks and categorisations have been suggested in gesture studies according to the domain application. However, McNeil (1992), whose work is referenced by the majority of researchers, suggested a gesture taxonomy based on a scaling continuum (Kendon Continuum): gesticulation, speech-linked, pantomime, emblems and sign languages. In this continuum and "as one moves from gesticulation to sign language, two reciprocal changes take place. First, the degree to which speech is an obligatory accompaniment of gesture decreases. Second, the degree to which gesture shows the properties of a language increases." McNeil also, suggested four categories which include 90% of the gestures in the narrative discourse: iconic, metaphoric, and deictic (including abstract pointing), and beats. Cadoz (1994) categorised gestures according to their function into three types:

a) semiotic: those used to communicate meaningful information.

b) ergotic: those used to manipulate the physical world and create artifacts

c) epistemic: those used to learn from the environment through tactile or haptic exploration

Moreover, gestures can be multifaceted and fall under more than one categorisation depending on the complexity of the idea being communicated and the expressiveness of the subject (McNeil 2005).

Although far from exhausting the gesture taxonomy topic here, the above mentioned provide an adequate background in order to understand the kind of gestures encountered in fieldwork[9] and captured on personal cameras throughout this study. The majority of communicative gestures we analysed are either variations of gesticulation or speech-linked, while we also ascertained a plethora of ergotic and epistemic due to the nature of fieldwork processes. Such processes involve trowelling with different tools in order to manipulate the physical working environment (ergotic gestures) and subtle gesturing suggesting haptic exploration of finds and soil (epistemic gestures) (Fig. 10-13). However, of all gestures we found that those relating to communication are of particular interest.

From on-site observations and the video analysis we ascertained that the majority of around trench conversation is concerned with spatial details of the work taking place. As a result of this, gestures are largely concerned with their target spatial setting, such as the previously mentioned trowelling in-situ and pointing towards other nearby settlements, rivers and features. In fact, the spatial setting of these gestures is so important that it is not uncommon for one archaeologist to turn their back on another archaeologist whilst engaged in conversation in order to observe and gesture more closely around the object of interest. Not only does this take place on a more personal, one-to-one setting, but even when explaining theories to large groups, where the projection of the speaker's voice could be considered important; where possible, physical contact with the object under discussion is typically sought whereas, in other scenarios, this explaining/talking to the wall would typically be considered rude.

More specifically, when archaeologists were engaged in a conversation about spaces, structures, generally large features of their working environment and their orientation, morphology or distribution, they tended to exaggerate their bodily movements and open up their hand gestures (Fig. 8). On the contrary, conversations about small finds or particular areas of interest tended to be accompanied by subtle gesturing performed in order to link their expressed ideas with a physical point of reference or disseminate more efficiently an interpretation (Fig. 9). Furthermore, the latter gestures regarding smaller features and finds are performed to an accurate scale where possible. For example, on one occasion a P#5 was discussing the mortar line surrounding a brick with a colleague. She performed a gesture depicting the brick and then traced the mortar line's path around it. These gestures were to the exact scale of the brick in question. What is interesting about this example is that the target of her gestures was on the opposite side of the trench area and would no doubt have benefited from an enlargement of the scale, but instead it seemed more important to the archaeologist to be as factually accurate as possible. On another occasion, a trench supervisor (P#8) was explaining the texture of a pot to a group of people. He performed a gesture that appeared to depict the texture around the lip of the pot. Again, he performed the gesture true to the size of the pot in question even though there was a considerable audience at a distance of a few meters away. The one concession he did make here was that the gesture was performed further from his body. We could argue then, that regardless of the distance between the subject and the audience or the object under discussion, gestures tend to be performed with accuracy in mind. The aforementioned gestures are

[9] It is important to note here that linguistic anthropologist Charles Goodwin has used video extensively at archaeological fieldwork and laboratories as an analytical observation tool in order to reveal the communicative affordances of "embodied action" (1994, 1999, 2000, 2003 & 2006).

typically categorised under semiotic gestures and more specifically, those that are used simultaneously with speech to convey information about size, shape or orientation are called iconic, while those pointing to entities or direction are called deictic. We also found that iconic or epistemic gestures occurred simultaneously with deictic gestures when for instance a conversation evolved around the identification and description of a possible bone artefact (Fig. 14-16) (also see Goodwin 2003, 229-230).

Fig. 8 An instance of participants discussing their excavation strategy to investigate the configuration and construction techniques of two joint walls. The gesture occurs when the person to the right suggests taking out one brick layer in an area of 50x50 cm in order to be able to understand the linkage of the perpendicular walls.

Fig. 9 In the same scene as in fig. 8 the person to the left points to a particular area of the wall suggesting that this area is characterised by mortar residues and thus, it is easier to understand what he is digging at that area**.**

Fig. 10-11 Examples of ergotic gestures used in fieldwork.

Fig.12 Example of epistemic gesture with haptic exploration of a pottery sherd.

Fig. 13 Example of epistemic and deictic gestures while interpreting a bone artefact (possibly axe handle).

Fig. 14-16 A sequence of images from a scene, where an archaeologist uses a combination of iconic and deictic gestures to describe the shape, the point of adhesion and direction of a possible 'missing' handle.

Another observation in relation to movement is that the pace of excavating differs depending on the nature of the context or the level of understanding of the context that is being excavated. Analysis of the videos identified slow and indecisive movements, fast and vigorous paced troweling, explorative or procedural ways of interacting with archaeological materials. Such variations in gesturing are largely picked up by the camcorder, a fact which adds another layer of documentation which has to do with the modes of interacting with the archaeological material and the state of being while performing certain actions. In the case of video documentation as note taking (in addition to commentary and a keeping-note-to-self type of narration) video segments are also characterised by a range of deictic, ergotic and epistemic gestures and movements, such as pointing at certain locations, excavating, moving between and pointing at certain spaces. We choose to call all the above gesture types "situated gestural narratives"[10], as opposed to oral narratives because they are subjective and complementary modes of communicating a hypothesis, an observation or a story.

The role of camera positioning in the recordings was, at its most basic, a question of making sure that the object of interest was in the frame - whether it would be two people in discussion, a feature or a process. However archaeologist-users also began to employ camera position in more conscious and more varied ways and, where the emphasis was on visual record, the positioning of the camera in relation to excavation processes became the main tool of narration. In these cases the near eye level camera approximates the point of view of the archaeologist-user and his or her voice, if heard, comes from behind the camera as a voiceover narration, whether making a 'note to self' or addressing one or more other people. A characteristic example of 'note to self' type of narration with predominant visual cues follows:

P#8: *((trowelling)) there's a lot: of finds in this area (.) º(and a lot of) larger findsº* (hhh) (.hhh) (hhh) the finds seem disturbed (hhh) (.hhh) (which show pick lines) but then once you get to this level (hhh) (.) ((pointing *gesture)) all the way around they are just (.) coming in spades (.9) ↑as you can see (.) ((turn of head)) lots of*

[10] The term situated is used here as per Suchman's understanding of the term in Human Machine Reconfigurations: Plans and Situated Action (2007). In essence, situated actions are actions that presuppose a shared cultural and historical frame for meaning making and archaeological fieldwork is certainly a research space where such conditions apply.

pottery (hhh) lots of (.hhh) (hhh) bones lots of ground stones ((picking up ground stone)) including this covered in (.) red ochre (.) > ((fiddling ground stone)) it looks like it was covered after it was broken too which is kind of interesting < ((trowelling)) (.42) hm::: it looks like another (.hhh) ground stone (hhh) coming out of the wall

This type of combined visual and oral narration captured in audio-visual format enables archaeologists to keep a type of diary with high definition information consisting of: a) oral notes providing an instant account of the types of finds, their occurring frequency and spatial distribution, and accompanied by sound annotations (notice the 'high pitch', 'stretch' and 'speed' notations in the narration above) b) visual notes of the mentioned finds, spaces and the interactions of the archaeologist with them (notice the types of gestures observed in the recording). These findings have various implications. In addition to the value of being able to revisit the context and sequence of interpretation, the evaluations also testified to the fact that the embodied nature of the interpretation and the gestural and voice tone annotations captured by the camera provided an additional colourful and varied pallet of expression to the interpretations, which would be most certainly missed by other conventional means of recording.

Emotions such as happiness, excitement, frustration and doubt, uncertainty and cautiousness captured by the PVR may also be encountered while we are disseminating our interpretations; and these expressions are important as they either reinforce or weaken our interpretations. As P#1 comments: *"…I realised that what I was thinking at the time gets confirmed by the constant troweling of the wall…and you can hear the reassurance* and gradual excitement in my voice when I say to others I found a course of stones as it was revealing slowly *from the soil…I almost sound happy and I don't think this is ever captured by conventional recording".* The conjunction of narrative and argument that characterises these video documents thus offers to the viewer, who revisits them, the opportunity to "insert herself into a process of argument, rather than having to consume pre-packaged, supposedly "neutral fare" (Hodder 1992).

The above identified narrative types enabled by personal camera recordings have but one common denominator, which is the "things" under investigation. Olsen et al. (2012) in Archaeology: The Discipline of Things mark out and refocus the primary role of archaeology in dealing, and engaging with the material remains of the past in order to chart an inherently object-oriented discipline in broader and timely interdisciplinary debates. This engagement with materiality is also a process that could not have been realised without the employment of a series of media from the early stages of fieldwork to publication, dissemination, and co-production of knowledge about past cultures as Olsen et al. suggest (2012: 80). Needless to say that different media provide diverse modes of engagement with the same object of study. Leaving aside common but robust documentation methods such as photography, consider the fidelity, accuracy, and rendering qualities in artefact images offered by Reflectance Transformation Imaging (RTI) and the 3D textured documentation of spaces provided by advanced photogrammetric techniques. In those examples, the object of study is not only reproduced to be scrutinized repeatedly, but with the use of the equivalent interactive software its properties are highlighted, magnified, and annotated; allowing undoubtedly different and multiple engagements than the ones enabled by an original object. Even in the reproduction form, the centerpiece of the digital scene/artefact is still the physical object, a fact which we would find challenging to justify in the case of third party video recording, where the archaeologist and the interpretation expressed emerge as the protagonists of the digital scene. On the contrary, and as it is evident from the captured scenes, the personal recording approach restores "things" as the protagonists of video documentation, and thus, of interpretation at the trowel's edge. Moreover, the above

delineated narrative styles offer imaginative ways of highlighting - in the form of visual, acoustic, bodily and gestural based annotations – the objects' qualities, properties and meaning. The smooth sound of scraping raw clay as opposed to a plaster layer, the movement of the trowel against a floor or a loose filling, the wording (as acoustic annotation) of the texture felt between one's index and thumb by crumbling a sample of soil as "pure silk" or the recorded announcement "find of the day!" (see Knibbe et al. 2014 for the dialogue that took place) about the bone artefact in figures 13-16, the fragile presence of a mineralised timber whose parts decompose at a single touch of a soft brush; all the above scenes are some of the numerous examples capturing the qualities of things, which are revealed, enriched and manifested through our interactions with them.

Then a further point is that, as well as providing embodied records of our research objects, oral, gestural and emotional variation within these recordings could also be technologically explored and utilised as a complementary mechanism to automate – perhaps at a basic level - the processes of editing, annotating and archiving video data. The collaboration between discourses of narrative and computer science such as Natural Language Processing (NLP) has returned interesting work on automated processes of detecting and retrieving affective information in text and multimedia resources (Francisco et. al 2006, Francisco & Gervas 2008, Wang &Wang 2011) which our discipline ought to consider.

Conversations that matter: Uncertainty and Reflexivity

The really interesting captured conversations, according to the participants, were those that evolved around certain aspects of the site and individual contexts, normally related to deposition processes or certain structures. Those conversations included clear arguments on the respective subject matter but also reveal certain aspects of the interpretive process that are hard to capture, identify, and include on the official record otherwise. For instance, one of the conversations evolved around the notion of uncertainty, which initiated from an observation on the preservation of mortar. In fact, uncertainty and cautiousness as a self-reflective critique that came out from the process of revisiting fieldwork practice was reported quite a few times. This illuminates the fact that interpretation is a process, and sometimes a rather complex one, with no predetermined path to certainty. The videos capture this process at different points and highlight the changes of the process itself. This way the videos may be used for reflection on a learning curve and a gradually growing understanding of a material but also a critical stance towards the certainty of statements in the archaeological record, acknowledging the process behind.[11]

Participant's #2comment on a video scene where he excavates with a colleague is characteristic of the above: "*We're both way too cautious! We're again confused by the natural concretion that covers Roman concrete,* which is exacerbated by the uneven surface created by robbing. I now know *that you'll know when you hit it*". For P#2, the ability to revisit his excavation process made him rethink the way he is handling his research material and operating within his research environment. He characteristically states: "*I'm taking an awful lot of* time trowelling and using the malapeggio to straighten the section, rather than continuing to pick through the rubble. I know in retrospect that this is because I am only now establishing the relationship between the rubble

[11] It should be mentioned that video is of course not the sole medium to be used to capture uncertainty in the interpretation process. For example, on the recording sheets of Çatalhöyük it is possible to record alternative interpretations with surety ratings of probability: high – medium – low.

packing and the foundation. I am trying to confirm that these, as well as, the layers above the top of the foundation, are later than the foundation and that they are dumped after the area was robbed and foundations *damaged. I guess I'm looking for any cuts for either construction or foundation in both plan and secti*on to be *sure I've got the sequence right. Little did I know that there is* a further 1-2m of rubble to go". Similarly, P#1 reported that it was made apparent to him by revisiting the video snippets that the narrative and interpretation he now has in his mind coincide with his earlier recorded observations; a fact which reinforces his current interpretations. He also observed that, while this fact gave him at present a certain confidence about the decisions and interpretations he was making six months earlier, he realised that he wasn't confident enough at the time that he was generating and expressing them. The impression he got, when he looked at the raw footage was that he was hesitating to express with certainty his observations and constantly discussing with his colleagues in an attempt to confirm them.

Although, the notion of uncertainty is a well-known issue in archaeological research and considerable attempts to address it continue to appear on the subjects of spatial analysis and modelling uncertainty (Crema et al. 2010; Crema 2012), typology and classification (Hermon & Nicolucci 2002), stratigraphy (De Runz et al. 2007), and computer graphics and visualisation (Sifniotis 2012), there's little discussion on how uncertainty is dealt with on-site, at the very moment when something uncertain becomes solid after it is registered on the official records of the excavation – through the record photograph, surveyed line, context record and so on. An interesting example that sheds light on the above issue was picked up by the video analysis and concerns the conversation between two participants about the nature and configuration of construction materials found during the excavation. In one of the captured scenes, P#11 revealed two blocks of clay on a level which is considered to be close to the floor of the space excavated at the time. The participant, being uncertain as to whether those tiles were found in situ or not, starts a conversation with his colleague (P #6):

P#6: hm::: (.)

P#11: too much of a mess to be *a floor)(.)(and for me that's the problem)*

P#6: no*::: that's not a floor (hhh) (.)((trowelling)) I don't think˚ (.) it could be a chunk of construction* material, probably roof because I was in that (.) well, I say that >because today when I was in the lab bagging stuff< (.hhh) (there was a large crater) of roof material that just looked like giant blocks of clay that they call *roof (.) it could be (.) ((aagh)) hm::: it's one* block *there right? And that's another block [next to it]*

P#11: [aha, yeah]

P#6: *it's not flattened really it could be fallen from above (.hhh) if you ca:n try to define it (.) the edges you* know? (.) get the outline of it (.) and it may be sitting on the floor but if it comes out as one piece [we can-]

P#11: ((gesturing a point on the ground))[(inaudible)]

P#6: is there more?

P#11: (inaudible)

P#6: if it comes out as one piece (.) collect it and take it out as possible roof (.) or construction material

P#11: probably it has this (.)[inaudible]

P#6: [((trowelling)) now see? yeah] (.) it*'s curving (.) it's a block of something (.) it might be ((trowelling))(1.3) yeah, see::: it's not flo:or it's an isolated block (.) I bet (.)* (hhh) *it's really soft (.) I bet its* construction material and I bet if you define it around here get this out ((trowelling)) you can ultimately lift it out.

From the sequence above, the observer can identify a climax when uncertainty about a find has progressed into almost certain explanation; something worth betting on. This captured scene reveals a process that involves two excavators with their expertise, several arguments accompanied by gesturing to specific areas, troweling to test the initial hypothesis and the textures, and referencing to previous experiences. This pluralistic mode of interpretation in archaeological fieldwork reveals the elusive processes that take place between researchers and between researchers and the research material which rarely find their way into the official records. The consequences are well known in the discipline; when a post excavation researcher reads in the official record "possible construction material" none of the aforementioned accompanying clues are usually at his/her disposal to aid the synthesis of many possible contextual finds and materials. Such uncertainty might subsequently be mediated by the use of statistical approaches emphasising the probable implications of multiple, intertwined uncertain interpretations across a site. Alternatively, and more commonly, the recording and publication processes will transform what was an expression of uncertainty into a discrete answer – in this case it becomes construction material. We propose that by associating such records with the forms of narrative captured via the cameras it becomes possible for subsequent researchers to review the interpretations and potentially to revise them. This way uncertainty and ambiguity may stay in the record, even though the interpretations take on a more certain tone in the end (cf. Gero 2007). Here the process would not be an automated one (as in probabilistic logic approaches) but rather one centred again on archaeological expertise.

Surveillance Issues and Awareness

Firstly, it is important to note that in the case of the Portus study we encountered varied reactions from the team members towards the nature of the study and more particular towards the medium used. On one hand, there were a few concerns with regards to the surveillance aspects of the method. Certain members of the excavation team expressed those concerns either by opting out from the filming process or by targeting the wearable camera user with their personal cameras to reclaim control over the act of recording. On the other hand, we observed that archaeologists who agreed to make use of the cameras were enthused with the new medium and its affordances in capturing on-going events and interpretations at fieldwork. Furthermore, as soon as the ethical part of the procedure was explained and the first recordings were shared among the participants any raised discomfort was moderated. On the contrary, at Çatalhöyük most members of the team were keen to participate, since they were already familiar with such recording practices and the theoretical drive behind them (Hanson & Rahtz 1988; Hodder 1995 & 2000; Brill 2000) hence, they understood the potential of using the device in fieldwork to record instances associated with their work. Surprisingly, the majority of interviewees felt that the awareness of recording devices had no significant impact on their usual conduct at fieldwork but they did offer substantial feedback on the ways it influenced them or thought how it may influence them if this was a fully adopted method.

The fact that more than one recording device is available for synchronous use and that more than one person is in control of them was reported to have significantly minimised any surveillance issues. Privacy and monitoring issues in academic environments were raised but it was generally admitted that these issues can be eliminated provided that each user and each person featured in the footage has editing rights and control over which video segments can be added to the permanent archive. The "fishbowl" feeling mentioned by Morgan

(2012: 90) is mitigated by the allocation of recording control to the excavators and to more than one person. Indeed at both sites it was made very easy for those included within given footage to review that footage and to delete it before any analysis was undertaken. At the point of writing no footage was deleted and only one instance captured accidentally was reported to include an intense conversation that shouldn't probably go on record as is.

In terms of the awareness of a recording device in function and personal behaviour during fieldwork, participants reported that using such devices makes archaeologists more conscious about how they express themselves on camera: how they communicate their ideas changes because they no longer address only the team members (where certain language codes have developed) but also other colleagues from the broader project. As P#5 reported: "*I noticed from watching the first clips that I wasn't conscious of the language I use on*-site. My *colleagues know by now what I mean when I tell them to make something 'pretty'. They know I'm referring to* brushing the excavated area, getting rid of trowel marks and prepare the area for photos. But the expression *'make it pretty' I normally use is not very understandable t*o others neither very professional. So now, I try to say what I actually mean each time. I often also report on camera something that happened a few days ago despite the fact that the excavator knows about it." This example brings up once more the notion of situated actions and their dependence on the context in which they are expressed (Suchman 2007:78). On reflection, the participant feels the need to change aspects of the team's communication codes in order to be understood by a wider audience and this need is dictated by the presence of the camera. It also brings up the issue of self-censorship and choice of words. The camera prompted this person to adjust the language to be more professional and appropriate. However, the language used in the trench is also a professional language, albeit closer to a jargon, which can also be significant for processes of learning and processes of interpretation.

While the majority of participants responded that they wouldn't mind for their recorded material to be shared by the project members, others raised issues of exposing oneself to other people's criticism with regards to work conducted on-site. To illustrate this, P#8 stated that: "*It could bring up some issues in terms judging one's way* of excavating. Especially in archaeology, the way you dig is a very personal thing and we tend to think that we are *very good at what we are doing and we don't necessarily like criticism and judgment from others…depending on who's watching the videos and what for, some people might feel like they are censored.* The thing with archaeology is that you work so hard in the field that a lot of the release comes verbally – we make jokes and talk around a lot; so there is a worry that people will judge you based on what you say." High profile examples, such as the recent conviction of a British soldier for murder in Afghanistan, which was recorded on a helmet-camera (Morris & Norton-Taylor 2013), and the use of wearable cameras by police officers in California which reduced both public complaints about the police and police violence (Ariel & Farrar 2013), show how the use of wearable cameras has become bound up with questions of professional liability and legal process. While these examples from war and policing would seem on balance to have had a beneficial effect for society, the possibility that PVR might be used as evidence for archaeological 'crimes' of uncertainty, erroneous interpretations, unfavoured techniques and so on, is not so positive. As mentioned previously, it has been noted in other contexts that attempts to implement reflexive methodologies have been criticized for surveillance and control issues. Uncertainty of how the recorded information is going to be used has created a feeling of distrust and an unwillingness to be openly self-critical. It has been noted that it takes confidence to show reflexive "weakness" and self-criticism (Berggren 2009; Chadwick 2003:102). Reflexivity is intricately

bound to issues such as hierarchy and power relations, issues that have also created problems with the implementation of the reflexive method at Çatalhöyük (Berggren & Nilsson, in press).

Narration, Audience and Address

It is worth noting that the above discussed concerns about privacy and the risk of exposure are closely linked to the properties of intimacy and immediacy particular to the wearable camera as personal recording interface and lens of reflection. Our findings suggest that both the camera and its digital outputs function as a kind of prosthesis (McLuhan 1994), which the archaeologist-user comes quickly to regard as a kind of extension of self and process (Chrysanthi et al. 2012, Malafouris 2012, Olsen et al. 2012, Shanks & Webmoor, 2013). Although the archaeologist-users exhibited conscious strategies of narration, at the same time, the permanent artefacts that they were producing, through the employment of the personal recording devices, were only fully apparent once the resulting first person narratives became separate documents of reified experience that might be viewed by others. At this point, the intimacy, immediacy and detail of their revelations sometimes became troubling, as well as helpful. The question of who is the audience for these video documents is thus a highly pertinent one, which has significant implications for their use and also for their mode of narration. Are these videos most suited to short-term use by excavators and their close collaborators or could the sensory and temporal data that they record be of value as a long-term record, to be accessed by a wider audience? Might they ever be made part of a public record? Ambiguity and uncertainty over this question is indeed already present in the narrative strategies of the archaeologist-users in this study. While some seem to be very much narrating 'notes to self', others seem to address an imagined audience, as in the example cited above, where the archaeologist – having reflected on his/her own narration in early videos – changed its style and content in later ones, in order to make it more intelligible to a potential viewer. Some users seem even to address their narration more to the camera, as if it were a co-participant in their activities. Indeed, since the camera provides any subsequent viewer of the video with the archaeologist-user's own point of view on the activities recorded, the perspectives of archaeologist, camera and audience are tightly overlapped in these narratives in a way that is comparatively novel and to date underexplored, not only in archaeology but in visual culture in general. This makes the question of mode of address a complex one, where ambiguity is likely to persist.

However, if the ultimate use of the videos were defined, it is likely that this would affect archaeologists' use of the cameras and result in certain conventions of style and content becoming more prevalent than others. We draw this hypothesis having some indications from the analysis of videos captured by a group of first year students at Portus. The students used the personal recording device while a Massive Open On-line Course (MOOC) filming was taking place at the site. Their resulting personal videos exhibit similar narrative characteristics to the MOOC recording process (that participants had already experienced from various positions such as narrator, spectator, assistant etc.), where the narrator mainly addresses an imaginative audience in a didactic style. As wearable cameras and first-person perspective become increasingly prevalent across visual culture, a range of conventions is likely to develop, on which archaeologists may draw.

Conclusions

To conclude, the qualitative data gathered from the evaluations provided further insight into the use of video recording as a means of documenting and reflecting on archaeological research, and revealed the affordances of the PVR approach, but it also raised many research questions which need further investigation.

Overall, the evaluation demonstrated that personal recording devices could potentially be of great value to archaeologists and the interpretative process. We believe that the use of video as a personal tool of interaction and reflection revealed possibilities not available in the use of video recorded by a detached observer. The recording of first-person narratives of excavation resulted in embodied and temporal records of material features and interpretations, which were rich in data not usually recorded in other forms of archaeological documentation. Furthermore, the personal use of the camcorder and the democratisation of the recording process by providing control over the medium's appropriation to more than one person or a designated team - as opposed to third party video - changes radically the way archaeologist think about this tool and eases significantly issues pertinent to surveillance and discomfort of being observed. The relative speed and ease with which the users in our study were able to adapt both their own practices and the affordances of the camera, in order to best achieve their own aims in using it, are also strong indicators of the potential of wearable cameras as flexible tools of documentation, reflection and dissemination, which can be customized and easily adapted by users. The possibility to create a record on video adds spatial, sensuous and bodily aspects to the documentation, which enables the excavator as well as other researchers to revisit the circumstances of a certain find, as we have demonstrated. However, the possibility to retrace a sequence of events and a process of interpretation through carefully performed documentation does not mean that the excavation can be remade. The decisions are made, and the chain of events cannot be changed. But the conditions of these decisions can be made more transparent and accessible. Another question which merits further investigation is that of the relative value of personal video records in different contexts of documentation and reflection: as an aid to ongoing interpretation; as an aide-memoire for post-excavation analysis; as a long-term record of an excavation, and as a mode of dissemination – between colleagues, but also potentially to a wider public. In interrogating the latter, it will also be necessary to investigate the issues of private and public data raised above. Besides, in order to address the above research questions it would require a dedicated and purpose-designed research project as well as long-term engagement of the archaeologists with the medium and the method in order to assess the impact on official records.

While our study has demonstrated the affordances of existing off-the-self head mounted cameras, it has also delineated some design lessons for a purpose built camera for archaeological fieldwork including the requirements in adequate image quality, field of view and operation interactions. Our small scale evaluation of Synote has also gone some way to ascertain how archaeologists would use a media annotation system, how effective this is for archaeology and also to suggest improvements. It suggests that such systems are appealing to researchers in archaeology, encouraging personal handling of video documentation and hence, intensifying video's active role in the rest of the archaeological record. One of the main challenges in making PVR more effective in aiding fieldwork is to provide an intuitive annotation mechanism for the video segments and facilitate archiving and retrieving processes. As per our suggestions above in this article, this could be done perhaps by shifting our attention to synchronous with video recording capture and annotation mechanisms and

by permuting refinement processes in the post-excavation seasons. Archiving, annotating and revisiting personal videos are still quite time-consuming tasks even if the work load is spread across more people. Nonetheless, we cannot ignore the potential of the method, given the benefits of a decentralised workflow for media-based documentation. Besides, the fact that during the study, PVR was not an established method (performed within the frame of participants' daily workload) may have influenced and limited our observations. Also, it is important to be able to link such data to the rest of the archaeological record since previous experience has shown that the lack of rich contextual links that could be associated with the project's database is the principal reason why such data are under-inspected by the team members. This latter issue touches upon broader database structure and linked data issues that were not in the intentions of this study.

The outcomes of this study, as well as strengthening the arguments in favour of video recording in archaeological research and providing a critical evaluation of PVR, indicate new directions for the development of technologies enabling the latter; namely, to minimise time consuming video processing and to make the most relevant of gathered data more easily accessible to researchers. Having said that, we do not claim to have delineated any technological solutions to our evaluation finds but we nevertheless demonstrate here that the method itself is a high resolution observation tool for providing insights towards future technological and theoretical developments in the discipline.

Acknowledgements

This work was funded by the RCUK Digital Economy Programme through the PATINA project, grant EP/H042806/1. Firstly, we would like to thank all our colleagues who participated in this study and for providing their valuable feedback and insights. We owe our gratitude to Ian Hodder and the Çatalhöyük Research Project, particularly the West Mound and East Mound excavation teams, as well as to Simon Keay and The Portus Project for their collaboration and support. We would also like to thank Dr. Mike Wald, Yunjia Li and the MACFoB (Multimedia Annotation and Community Folksonomy Building) project, University of Southampton for trusting us to conduct an evaluation of Synote, and Hembo Pagi for the technical assistance in conducting the evaluation. Finally, we are indebted to Ian Hodder, Sara Perry and our anonymous reviewers for providing their valuable comments on previous versions of this article.

References

Ariel, B & Farrar, T. (2013). Self-awareness to being watched and socially-desirable behavior: a field experiment on the effect of body-worn cameras on police use-of-force. Police Foundation http://www.policefoundation.org/content/body-worn-cameras-police-use-force. Accessed 23 February 2014.

Beale, T.W., & Healy, P.F. (1975). Archaeological Films: The Past as Present. American Anthropologist, 77(4), 889-897.

Berggren, Å. (2009). Evaluation of a Reflexive Attempt: The Citytunnel Project in Retrospect. In Archaeological Review from Cambridge, 24(1), 23-37.

Berggren, Å. & Hodder, I. (2003). Social practice, method and some problems of field archaeology. American Antiquity, 68 (3), 421–34.

Berggren, Å. & Nilsson, B. (In Press). Going back, looking forward. Reflexive archaeology or reflexive method? In I. Hodder (Ed.), Integrating *Catalhöyuk. Themes from the 2000* – 2008 seasons (Vol. 10). Çatalhöyük Research Project.

Cadoz, C. (1994). *Les réalités virtuelles*. Paris: Dominos-Flammarion.

Brill, D. (2000). Video-recording as part of the critical archaeological process. In I. Hodder (Ed.), Towards *reflexive method in archaeology: the example at Çatalhöyük* (pp. 235-238). Cambridge: McDonald Institute of Archaeological Research.

Bush, V. (2003). As we may think. The new Media Reader, 35-28.

Calbris, G. (2011). Elements of Meaning in Gesture. Amsterdam: John Benjamins.

Camurri, A., & Volpe, G. (2004). Gesture-Based Comminication in Human-Computer Interaction. LNAI 2915. Springer-Verlag.

Caridakis, G., Karpouzis, K., Drosopoulos, A., & Kollias, S. (2009). SOMM: Self organizing Markov map for gesture recognition. Pattern Recognition Letters, 31 (1), 52-59.

Chadha, A. (2002). Visions of Discipline: Sir Mortimer Wheeler and the Archaeological Method in India (1944-48). Journal of SocialArchaeology, 2(3), 378-401.

Chadwick, A. (2003). Post-processualism, professionalization and archaeological methodologies: Towards reflective and radical practice. Archaeological Dialogues 10(1), 97–117.

Chyrsanthi, A., Murrieta Flores, P. & Papadopoulos, P. (2012). Archaeological Computing: Towards Prosthesis or Amputation? In A. Chrysanthi, P. Murrieta Flores & C. Papadopoulos (Eds.), Thinking Beyond the Tool. Archaeological Computing and the Interpretative Process. (pp. 7-13). BAR International Series 2344. Oxford: Archaeopress.

Clack, T., & Brittain, M. (2007). Archaeology and the Media. Walnut Creek, Ca: Left Coast Press.

Conolly, J.W. (2000). Çatalhöyük and the Archaeological 'Object'. In: Hodder, I. (Ed.), Towards reflexive *method in archaeology: the example at Çatalhöyük* (pp. 51 - 57). Cambridge: McDonald Institute of Archaeological Research.

Crema, E. R., Bevan, A., & Lake, M. (2010). A probabilistic framework for assessing spatio-temporal point patterns in the archaeological record. Journal of Archaeological Science, 37, 1118-1130.

Crema, E. R. (2012). Modelling Temporal Uncertainty in Archaeological Analysis. Journal of Archaeological Method and Theory, 19, 440-461.

De Runz, D., Desjardin, E., Piantoni, F., & Herbin, M. (2007). Using fuzzy logic to manage uncertain multi-modal data in an archaeological GIS. In Proceedings of International Symposium on Spatial Data Quality. Resource document.

http://www.isprs.org/proceedings/XXXVI/2-C43/Postersession/runz_et_al.pdf. Accessed 16 January 2014.

Edgeworth, M. (2006). Ethnographies of archaeological practice. Cultural encounters, material transformations. Lanham: AltaMira Press.

Francisco, V. & Gervás, P. 2008. Ontology-supported automated mark up of affective information in texts. Special Issue of Language Forum on Computational Treatment of Language, 34(1), 23-36.

Francisco, V., Hervás, R. & Gervás, P. (2006). Two different approaches to automated mark up of emotions in text. In Proceedings of AI 2006 (pp. 101-114). Cambridge: Springer Verlag.

Gaver, W., Boucher, A., Pennington, S. & Walker, B. (2004). Cultural probes and the value of uncertainty. Interactions-Funology, 11(5), 53-56.

Gero, J. (2007). Honoring ambiguity/problematizing certitude. Journal of Archaeological Method and Theory, 14(3), 11–327.

Goodwin, C. (2006). A Linguistic Anthropologist's Interest in Archaeological Practice. In M. Edgeworth (Ed) Ethnographies of archaeological practice. Cultural encounters, material transformations (pp. 45-56). Lanham: AltaMira Press.

Goodwin, C. (2003). Pointing as Situated Practice. In S. Kita (Ed) Pointing: Where Language, Culture and Cognition Meet (pp. 217-242). Mahwah, NJ: Erlbaum.

Hanson, W. S., & Rahtz, P. A. 1988. Video recording on excavations. Antiquity, 62, 106-111.

Heath, C., Hindmars, J., & Luff, P. (2010). Video in Qualitative Research: Analysing social interaction in everyday life. London: Sage.

Hermon, S., & Nicolucci, F. (2002). Estimating subjectivity of typologists and typological classification with fuzzy logic. Archeologia e Calcolatori, 12, 217-232.

Hodder, I. (1992). Theory and Practice in Archeology. London: Routledge

Hodder, I. (1995). Video Documentation. In Catal News 2: Newsletter of the Çatalhöyük Research Trust. http://www.catalhoyuk.com/newsletters/02/video.html. Accessed 25 March 2013.

Hodder, I. (1997). Always Momentary, Fluid and Flexible: Towards a Reflexive Excavation Methodology. Antiquity, 71, 691–700.

Hodder, I. (Ed.). 2000. *Towards reflexive method in archaeology: the example at Çatalhöyük*. Cambridge: McDonald Institute of Archaeological Research.

Hutchins, E. (1995). Cognition in the Wild. Cambridge MA: MIT Press.

Kendon, A. (1988). How gestures can become like words. In F. Poyatos (Ed), Crosscultural Perspectives in Nonverbal Communication (pp. 131-141). Toronto: C. J. Hogrefe Publishers.

Kendon, A. (1994). Do Gestures Communicate? A Review. Research on Language and Social Interaction, 27(3), 175-200.

Kendon, A. (2004). Gesture: Visible Action as Utterance. Cambridge: Cambridge University Press.

Kraemer, C.J.JR. (1958). The Archaeological Film. Archaeology, 11, 262-266.

Knibbe, J., O'Hara, P.K., Chrysanthi, A., Marshall, M.T., Bennett, P.D., Earl, G., Izadi, S. & Fraser, M. (2014). Quick and Dirty: Streamlined 3D Scanning in Archaeology. In Proceedings of *CSCW '14* (pp. 1366-1376). New York: ACM.

Lahlou, S. (2009). Experimental reality: Principles for the design of augmented environments. In S. Lahlou (Ed.), Designing User Friendly Augmented Work Environments: From Meeting Rooms to Digital Collaborative Spaces (pp.113–158). London: Springer.

Lahlou, S. (2011). How we can capture the subject's perspective? An evidence-based approach for the social scientist. Social Science Information, 50 (3-4), 607-655.

Laude, J. (1970). Cinéma et Archéologie. In *Catalogue de Films d'Intérêt Archéologique, Ethnographique ou* Historique (pp.11-53). Paris: UNESCO.

Malafouris, L. (2012). Prosthetic gestures: How the tool shapes the mind. Behavioral and Brain Sciences, 35 (4), 28-29.

Mann, S. (1998). Humanistic intelligence: WearComp as a new framework for Intelligent Signal Processing. Proceedings of the IEEE, 86(11), 2123–2151.

Mann, S., Fung, J., Aimone, C., Sehgal, A. & Chen, D. (2005). Designing EyeTap Digital Eyeglasses for Continuous Lifelong Capture and Sharing of Personal Experiences. In Adjunct Proceedings ALT.CHI 2005. New York: ACM.

McLuhan, M. (1994). Understanding media: the extensions of man (first edition 1964). USA: The MIT Press.

McNeil, D. (1992). Hand and Mind: What Gestures Reveal About Thought. Chicago: University of Chicago Press.

McNeil, D. (2005). Gesture & Thought. Chicago: University of Chicago Press.

Morgan, C. (2012). Emancipatory Digital Archaeology. Doctoral thesis, University of California.

Morris, S & Norton-Taylor, R. (2013). Marine faces life term after being found guilty of 'executing' Afghan insurgent. In The Guardian, 8 NovemberRakić, T., & Chambers, D. (2009). Researcher with a movie camera: visual ethnography in the field. Current Issues in Tourism, 13 (3), 255 – 270.

Nosulenko, V., & Samoulenko, E. (2009). Psychological methods for the study of augmented environments. In S. Lahlou (Ed.) Designing User Friendly Augmented Work Environments: From Meeting Rooms to Digital Collaborative Space (pp. 213–236). London: Springer.

Olsen, B., Shanks, M., Webmoor, T. & Witmore, C. (2012). Archaeology: The Discipline of Things. Berkeley, CA: University of California Press.

Potter, P. (1991). Self-reflection in archaeology. In Preucel, R. (Ed.), Processual and Postprocessual Archaeologies: Multiple Ways of Knowing the Past (Center for Archaeological Investigations Occasional Paper No. 10) (pp. 225–234). Carbondale: Southern Illinois University.

Shanks, M. & Webmoor, T. (2012). A Political Economy of Visual Media in Archaeology. In S. Bonde & S. Houston (Eds), Representing the Past: Archaeology Through Image and Text (pp.87-110). Oxford: Oxbow.

Sifniotis, M. (2012). Representing archaeological uncertainty in cultural informatics. Doctoral thesis, University of Sussex.

Stevanović, M. (2000). Visualizing and Vocalizing the Archaeological Archival Record: Narrative vs Image. In I. Hodder (Ed.), *Towards reflexive method in archaeology: the example at Çatalhöyük* (pp. 235-238). Cambridge: McDonald Institute of Archaeological Research.

Streeck, J. (2009). Forward Gesturing. Discourse Processes, 46(2-3), 161-179.

Suchman, L. (2007). Human-machine reconfigurations: Plans and situated actions (2nd expanded ed.). New York: Cambridge University Press.

Tringham, R., Ashley, M., & Quinlan, J. (2012). Creating and Archiving the Media Database and Documentation of the Excavation. In R. Tringham and M. Stevanović (Eds) House Lives: Building, Inhabiting, *Excavating a House at Çatalhöyük, Turkey: Reports from the BACH Area, Çatalhöyük, 1997*-2003 (pp. 31-48). Los Angeles: Cotsen Institute of Archaeology.

Wang, S. & Wang, X. (2011). Emotional Semantic Detection from Multimedia: A Brief Overview. In Y. Dai, B. Chakraborty, & M. Shi (Eds.), Kansei Engineering and Soft Computing: Theory and Practice (pp. 126-146). Hershey, PA: Engineering Science Reference.

Witmore, C. (2004). Four Archaeological Engagements with Place: Mediating Bodily Experience through Peripatetic Video. Visual Anthropology Review, (20.2), 57-72.