Examining the differences between the use of wearable cameras and traditional cameras in research – A research note

Gemma Wilson

Northumbria University, Faculty of Health and Life Sciences, Department of Healthcare, Newcastle-upon-Tyne, [gemma.wilson@northumbria.ac.uk](mailto:gemma.wilson@northumbria.ac.uk).

Photographic images allow data to be captured from an alternative perspective. Traditional, manual cameras are the most common method of recording photographic data, however, innovative technology is changing the way in which photographs can be collected. Wearable cameras enable a vast amount of photographic images to be captured, automatically, without user interaction. It is often assumed that photographic research methods are used for a similar purpose, engage participants in a similar way and yield a similar outcome, however, there are various differences between the use of traditional, manual cameras and innovative, wearable cameras. This research note offers a unique contribution to the literature by highlighting the differences between the use of traditional, manual cameras and wearable, automatic cameras within research.

Keywords: visual method, wearable camera, Sensecam, participatory photography, photovoice

**This is an accepted manuscript of an article published by Taylor & Francis in The International Journal of Social Research Methodology on 18th October 2016, available online: http://www.tandfonline.com/10.1080/13645579.2016.1242317.**

# Introduction

Visual methods are being increasingly used as part of research; shifting from being used primarily for illustration, to becoming a central component of data collection (Stanczak, 2007). Visual methods span various types of data, including analysis of film, portraits, graffiti and also photographs. The use of photographic images allows data to be captured from another perspective, without the confines of written or spoken language, and provides a deeper reflection of an individual’s ‘*everydayness’* that may otherwise be unseen in research (Pilcher, Martin, & Williams, 2015, p. 7). Photographs can be used to enhance other forms of data collection, such as the technique of photo elicitation, in which the research team use photographs as part of an interview or focus group schedule to generate further discussion between participants (Harper, 2002), or can be used in experimental studies to identify emotional responses experienced whilst viewing photographs, such as in the area of body dissatisfaction (Groesz, Levine, & Murnen, 2002). Alternatively, photographs can be a source of data in their own right. For participant-generated images, manual cameras are used to capture meaningful photographs, typically illustrating a specific aspect of an individual’s life. However, the progression of technology allows data to be captured in completely different ways, including photographic images which can be recorded automatically using wearable technology.

This research note stems from experiences of using a wearable camera to generate data as part of an exploratory research project involving older adults with chronic pain (Wilson, Jones, Schofield & Martin, 2013). Whilst disseminating findings from the project, and discussing the use of cameras as a data collection tool, it became apparent that the use of wearable cameras and manual cameras are often considered as being similar in their aim, method and outcome, despite both methods differing considerably. Wearable cameras are often considered as simply being a new, innovative technology that could replace traditional cameras, rather than being viewed as a distinct method of data collection. This research note offers a unique contribution to the literature by describing the differences between the use of manual cameras and wearable cameras as data collection tools.

**The traditional camera**

Participatory photography, also referred to as Photovoice (Wang, Burris, & Ping, 1996), is a visual method which requires participants to capture a small number of photographs representing an aspect of their community or daily living. The method was initially conceived as a community intervention, used to instigate local impact by allowing individuals (typically marginalised or underrepresented groups) to identify and represent their own community using photography (C. C. Wang, Cash, & Powers, 2000). However, the flexibility of Photovoice has been acknowledged and the method is now being used in a diverse range of settings, such as the impact of long-term health conditions (Baker & Wang, 2006; Williams, Sheffield, & Knibb, 2014), the effect of the physical and social environment on physical activity (Mahmood et al., 2012) and the investigation of commuting practices (Guell & Ogilvie, 2013).

Unlike photo elicitation, the photographs captured as part of studies using participatory photography are produced by the participants themselves, empowering participants through their engagement in the research process (Given, Opryshko, Julien, & Smith, 2011). Rather than data being constructed from the perspective of the researcher, methods of participatory photography place the participant at the centre of data collection, ensuring that data reflects their own construction of their social world (Prosser & Loxley, 2008).

As part of data collection, participants are given a digital or disposable camera, and depending upon the aim of the study, are asked to capture a small set of photographs, that are meaningful and representative of the area being explored. After capturing the photographs, participants are brought together in a focus group, or semi-structured interview, to convey meaning and contextualise the photographs taken (Given et al., 2011). The discussions enable participants to construct a narrative alongside the photographs, in order to understand the participant’s lived experience (Hergenrather, Rhodes, Cowan, Bardhoshi, & Pula, 2009).

**The wearable camera**

The prevalence and sophistication of ubiquitous, smart technology has led to a wave of interest in logging various aspects of our daily living using technology such as smartphones, tablets and activity trackers. Individuals can choose to log a plethora of personal information such as calorie consumption and energy expenditure which can be captured using software applications such as MyFitnessPal©, or can choose to log steps taken, distance travelled, calories burned and quality of sleep using activity trackers such as Fitbit© or Jawbone©. This self-recorded data is referred to as life-logging; the idea of automatically capturing several aspects of an individual’s life using technology (Caprani, Gurrin, & O'Connor, 2010). The wearable camera is one life-logging device that allows users to visually record various aspects of their day automatically, with little effort.

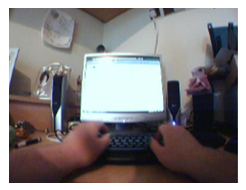
Wearable cameras have been used to capture passive image data in various areas of research. The predecessor of current wearable cameras, Microsoft’s® Sensecam (see Figure 1) was initially developed as a tool to support individuals with cognitive deficits (Berry et al., 2009; Berry et al., 2007) and to improve memory for events (Given et al., 2011; Sellen et al., 2007).



Figure 1. The Sensecam (Microsoft®)

The Sensecam soon evolved into a tool that has been used to capture a large frequency of automatic images in various areas of research, for example, to explore sedentary behaviour (Kerr et al., 2013), travel (Kelly et al., 2012) and nutrition (O'Loughlin et al., 2013).

The positioning of the wearable camera captures images from the individual’s own visual perspective, as the wearable camera is either worn on a lanyard, resting on the user’s chest, or clipped onto an item of clothing. Participants are generally asked to wear the camera all day, for a specified number of days. Wearable cameras can record 2-3,000 images for each 12 hours of use (Kelly et al., 2013), providing an in-depth picture of the individual’s daily habits, essentially recording a ‘visual diary’ of the user’s day (see Figures 2-5).

Figures 2-5. Sample images from the Sensecam (Microsoft®)

The photographs are recorded passively with very little interaction, or attention, from the user (Doherty et al., 2013). Once the individual turns the camera on, no further actions are needed unless they wish to turn the camera off or use the privacy button which stops the recording of images.

**How do manual cameras and wearable cameras differ?**

There are various differences between manual cameras and wearable cameras as both methods differ in the ethical considerations involved, the way in which they involve participants in the data collection process, the nature and extent of the dataset, and the analytical processes.

**Ethics**

The ethical considerations of using participant-generated photographs are a pertinent aspect of using both manual cameras and wearable cameras as photographs identify participants in an entirely different way to other research methods (Langmann & Pick, 2014). Ethical considerations of photographs highlight the importance of consent, clarity, accuracy and dissemination of the images (Langmann & Pick, 2014).

Despite the importance of ethical guidance for both methods, manual cameras and wearable cameras do differ in the nature of photographs recorded, as wearable cameras record images automatically and record a much larger dataset than manual cameras. The ethical considerations of using a wearable camera are a commonly debated topic for academics working in this area and necessitated the production of an ethical framework (Kelly, et al., 2013). The ethical framework proposes guidelines set out to ensure the privacy of both participants, and others that are present within the photographs, centring around informed consent, privacy and confidentiality, non-maleficence and autonomy of third parties. Whereas participant’s involved in methods of participatory photography have more control over the images that they record, wearable cameras capture images automatically, therefore it is possible that use of a wearable camera will lead to ‘*unwanted’* and ‘*unflattering’* photographs (Kelly, et al., 2013, pg. 315).

**Participant involvement**

Participants engage in both research processes in very different ways. Participatory photography is grounded in participatory action research, a methodology that accentuates the importance of co-producing research *with* participants rather than carrying out research *using* participants (Bergold & Thomas, 2012). Participatory action research sees the co-production of knowledge as being integral to the research process (Bergold & Thomas, 2012) and participants within participatory photography methods, such as Photovoice, are very much central to data collection, rather than being passive in the research process (Gurbrium & Harper, 2013). Participants are able to purposively choose to capture data that is meaningful to them and that they feel best represents their own experiences. This active involvement within the data collection process can help participants to feel empowered by their role in the research process (Given et al., 2011). Distinct to this, the dataset produced by wearable cameras is based on frequency of behaviours within the images and recognises the photographs as objective representations of daily living without any subjective meaning or values (Langmann & Pick, 2014). The participants are passive within data collection as once they have attached the camera to their clothing, other than being aware of the privacy of themselves and others, they do not have to consciously think about the camera or the photographs that they are taking as everything is captured automatically.

Within studies using participatory photography, participants also have the opportunity to provide a narrative alongside the photographs to give meaning and context to the data they have produced. Although a small number of studies using wearable cameras have collected additional qualitative data, such as diary exerts or semi-structured interviews (e.g. Wilson, *et al.,* 2013), this is dissimilar to the majority of studies utilising wearable cameras as they use the photographs as the central dataset, and do not capture additional information gaining personal insight from participants regarding the content of the images.

**Nature of the dataset**

There are differences in the type of data retrieved from both types of camera, including the size of the dataset.

The photographs recorded using manual cameras, in studies utilising the participatory photography method, are a very specific set of images that are meaningful to the participant. Each photograph is taken only when an individual chooses to pick up the camera and capture it. The participants are given time to consider which images they want to take, and reflect on their reasons for doing so. The photographs are taken as a way of representation, and are accompanied by a narrative exploring the content and importance of the image’s contents. Each image has meaning and significance to the individual and the contents of the image may be representative of more abstract meaning or symbolism therefore necessitating additional narrative alongside the photograph.

Wearable cameras act as a visual diary and, if worn over a long period of time, have the potential to record the user’s daily routine and patterns of daily living, specifically focused on the frequency of behaviours and the context in which they occur. The low user burden of wearable cameras enables photographs to be recorded when an individual is immersed in their day and would not otherwise pick up a camera, such as during sporting activities or household chores (Ljungblad, 2009). Photographs can also be captured that may not seem important to the participant, and may not have been captured using a manual camera, such as taking photographs during ‘*boring’* or ‘*mundane’* tasks (Ljungblad, 2009). Not only does the wearable camera record the tasks being carried out, but it also records the context in which they are taking place including if tasks are carried out alone or with others. Wearable cameras are useful in recording daily living as the data is more objective and accurate than self-report data, which can be disadvantageous due to recall biases or social desirability (McGlynn, Damberg, Kerr, & Brook, 1998).

The size of the dataset also differs considerably between both methods. Within methods of participatory photography each participant develops a small dataset of approximately 5-20 meaningful, well-considered photographs. In contrast to this, wearable cameras produce a considerably larger dataset as each participant generates approximately 18,000 photographs over a seven-day period. The manual browsing of photographs recorded on a wearable camera can be impractical, especially if recorded over a long period of time (Byrne, Doherty, Snoek, Jones, & Smeaton, 2010; Byrne & Jones, 2008). Tailored software, such as the DCU Sensecam application software (Doherty, Moulin, & Smeaton, 2011), is available to upload and store the images. The DCU Sensecam application software uses a content analysis technique to automatically store images into a series of events to facilitate and ease the browsing of images. However, the large volume of images means that the analysis of images can be a time-consuming task (Doherty et al., 2013), in some cases making it necessary for the dataset to be handled and analysed by a research team, as opposed to a single individual.

**Analytic process**

Studies utilising methods of participatory photography, and studies using wearable cameras, analyse retrieved data in contrasting ways. Despite photographs being central to the data collection process in participatory photography, analysis focuses on the narrative that arises from the discussion around the photographs, as opposed to analysing the photographs directly. Grounded in participatory action research, participants are involved in the co-creation of data, not only in creating the photographs themselves, but also in the dialogue surrounding the photographs. The photographs act as the basis for this dialogue in which the participant can provide explanation, perspective and significance of the contents of the photographs (C. C. Wang & Burris, 1997). Individuals contextualise the nature of the photograph and codify its contents within this discussion, highlighting emerging issues (C. C. Wang & Burris, 1997) and providing an insight into the individual’s own understanding of their own world (Pilcher et al., 2015).

Unlike participatory photography, studies using wearable cameras analyse photographs directly, most often using frequency-based statistics. Once data has been uploaded onto a software programme, allowing users to browse the images, a coding protocol can be implemented to identify behaviours from the dataset, and the context in which they occurred. The coding protocol should be objective, systematic and fully inclusive of all potential behaviours to be recorded from the dataset, allowing coders to annotate each image based on specified criterion, according to the aim of the study. An advantage to implementing a systematic coding protocol is that it enables multiple coders to analyse a single dataset, and lessens the burden of analysis for one individual, whilst ensuring reliability between coders (Kerr et al., 2013) . The use of multiple coders is assisted by the software on which the images are uploaded as this allows more than one user to log into a dataset. In order to ensure reliability of coding between a team of coders, comprehensive training should also be undertaken, and furthermore, it is preferable to test the inter-rater reliability of the coding protocol prior to the analysis of the images, using methods such as blind coding (Kerr et al., 2013). This helps to further ensure the reliability of the data analysis when using a team of multiple coders.

**Conclusion**

This research note set out to explore the differences between the use of traditional, manual cameras and wearable, automatic cameras in research. The use of traditional cameras results in a small, meaningful dataset that has been specifically chosen by the participant to represent something that is significant to them; the images do not reflect general daily living but represent one particular area of significance. The participant is central to data collection and analysis focuses on the narrative produced alongside the photograph, which gives meaning and context to the photograph. Contrastingly, wearable cameras are used to capture automatic photographs without any effort from the user, building up a vast number of images in the form of a time-lapsed visual diary. The images recorded by wearable cameras are not consciously chosen by the participant to represent a specific aspect of their being, but build a contextual picture of daily living. The images are objectively coded using pre-defined coding protocols, and are most often analysed using frequency-based statistics.

When considering an area such as physical activity, one may choose to use participatory photography method and choose to use manual cameras to explore the meaning of physical activity to the individual, or to further understand facilitators or barriers to participation within physical activity. Alternatively, a wearable camera would be used to record the type of physical activity carried out, or the frequency of sedentary behaviour, movement or participation within physical activity. The wearable camera could capture the context of the physical activity, including the social environment.

The catalyst for this research note arose from discussions with various academics regarding the use of participant-generated photographs within research and their assumption that the use of manual cameras and wearable cameras would produce similar data, therefore would be used with similar aims and utilise similar methods. From the discussion within this research note it is apparent that both methods differ greatly, in their aims, methods and outcomes. Despite photographic images being central to both data collection tools, they engage individuals in different ways. Both data collection tools generate a different type of data, are analysed in contrasting ways, and are therefore used when exploring different aims.

When considering using participant-generated photographs, it is important that the differences between the methods are understood and the most suitable research method is chosen.

Acknowledgements

I would like to thank my PhD supervisors, Professor Denis Martin, Dr Derek Jones and Professor Patricia Schofield, for introducing me to wearable cameras as a data collection tool.

Note on contributor

Gemma has an interest in the role of technology in healthcare; she is a senior research assistant in the Faculty of Health and Life Sciences of Northumbria University.

References

Baker, T. A., & Wang, C. C. (2006). Photovoice: Use of a participatory action research method to explore the chronic pain experience in older adults. *Qualitative Health Research, 16*(10), 1405-1413.

Bergold, J., & Thomas, S. (2012). Participatory Research Methods: A Methodological Approach in Motion. *Forum: Qualitative Social Research, 13*(1).

Berry, E., Hampshire, A., Rowe, J., Hodges, S., Kapur, N., Watson, P., . . . Owen, A. M. (2009). The neural basis of effective memory therapy in a patient with limbic encephalitis. *Journal of Neurology, Neurosurgery & Psychiatry, 80*(11), 1202-1205.

Berry, E., Kapur, N., Williams, L., Hodges, S., Watson, P., Smyth, G., . . . Wood, K. (2007). The use of a wearable camera, SenseCam, as a pictorial diary to improve autobiographical memory in a patient with limbic encephalitis: A preliminary report. *Neuropsychological Rehabilitation, 17*(4-5), 582-601.

Byrne, D., Doherty, A. R., Snoek, C. G., Jones, G. J., & Smeaton, A. F. (2010). Everyday concept detection in visual lifelogs: validation, relationships and trends. *Multimedia Tools and Applications, 49*(1), 119-144.

Byrne, D., & Jones, G. J. (2008). *Towards computational autobiographical narratives through human digital memories.* Paper presented at the Proceedings of the 2nd ACM international workshop on Story representation, mechanism and context.

Caprani, N., Gurrin, C., & O'Connor, N. E. (2010). *I like to log: a questionnaire study towards accessible lifelogging for older users.* Paper presented at the Proceedings of the 12th international ACM SIGACCESS conference on Computers and accessibility, Orlando, FL, USA.

Doherty, A., Hodges, S., King, A., Smeaton, A. F., Berry, E., Moulin, C. J., . . . Foster, C. (2013). Wearable cameras in health. *American Journal Of Preventive Medicine, 44*(3), 320-323.

Doherty, A., Moulin, C. J., & Smeaton, A. F. (2011). Automatically assisting human memory: a SenseCam browser. *Memory, 19*(7), 785-795.

Given, L. M., Opryshko, A., Julien, H., & Smith, J. (2011). Photovoice: A participatory method for information science. *Proceedings of the American Society for Information Science and Technology, 48*(1), 1-3.

Groesz, L. M., Levine, M. P., & Murnen, S. K. (2002). The effect of experimental presentation of thin media images on body satisfaction: A meta‐analytic review. *International Journal of Eating Disorders, 31*(1), 1-16.

Guell, C., & Ogilvie, D. (2013). Picturing commuting: photovoice and seeking wellbeing in everyday travel. *Qualitative Research, 15*(2), 201-218.

Gurbrium, A., & Harper, K. (Eds.). (2013). *Participatory Visual and Digital methods*. Walnut Creek, CA: Left Coast Press, Inc.

Harper, D. (2002). Talking about pictures: A case for photo elicitation. *Visual studies, 17*(1), 13-26.

Hergenrather, K. C., Rhodes, S. D., Cowan, C. A., Bardhoshi, G., & Pula, S. (2009). Photovoice as community-based participatory research: A qualitative review. *American journal of health behavior, 33*(6), 686-698.

Kelly, P., Doherty, A. R., Hamilton, A., Matthews, A., Batterham, A. M., Nelson, M., . . . Cowburn, G. (2012). Evaluating the feasibility of measuring travel to school using a wearable camera. *American Journal Of Preventive Medicine, 43*(5), 546-550.

Kelly, P., Marshall, S. J., Badland, H., Kerr, J., Oliver, M., Doherty, A. R., & Foster, C. (2013). An ethical framework for automated, wearable cameras in health behavior research. *American Journal Of Preventive Medicine, 44*(3), 314-319.

Kerr, J., Marshall, S. J., Godbole, S., Chen, J., Legge, A., Doherty, A. R., . . . Foster, C. (2013). Using the SenseCam to improve classifications of sedentary behavior in free-living settings. *American Journal Of Preventive Medicine, 44*(3), 290-296.

Langmann, S., & Pick, D. (2014). Dignity and ethics in research photography. *International Journal of Social Research Methodology, 17*(6), 709-721.

Ljungblad, S. (2009). *Passive photography from a creative perspective: If I would just shoot the same thing for seven days, it's like... What's the point?* Paper presented at the Proceedings of the SIGCHI conference on Human Factors in computing systems.

Mahmood, A., Chaudhury, H., Michael, Y. L., Campo, M., Hay, K., & Sarte, A. (2012). A photovoice documentation of the role of neighborhood physical and social environments in older adults’ physical activity in two metropolitan areas in North America. *Social Science & Medicine, 74*(8), 1180-1192.

McGlynn, E. A., Damberg, C. L., Kerr, E. A., & Brook, R. H. (1998). *Health information systems*. Santa Monica, CA, USA: RAND Health Corporation.

O'Loughlin, G., Cullen, S. J., McGoldrick, A., O'Connor, S., Blain, R., O'Malley, S., & Warrington, G. D. (2013). Using a wearable camera to increase the accuracy of dietary analysis. *American Journal Of Preventive Medicine, 44*(3), 297-301.

Pilcher, K., Martin, W., & Williams, V. (2015). Issues of collaboration, representation, meaning and emotions: utilising participant-led visual diaries to capture the everyday lives of people in mid to later life. *International Journal of Social Research Methodology, 19*(6), 477-692.

Prosser, J., & Loxley, A. (2008). Introducing visual methods. *National Centre for Research Methods Review Paper*. Leeds, UK.

Sellen, A. J., Fogg, A., Aitken, M., Hodges, S., Rother, C., & Wood, K. (2007). *Do life-logging technologies support memory for the past?: an experimental study using sensecam.* Paper presented at the Proceedings of the SIGCHI conference on Human factors in computing systems, San Jose CA, USA.

Stanczak, G. C. (2007). *Visual research methods: Image, society, and representation*. Thousand Oaks CA, USA: Sage Publications.

Wang, Burris, M. A., & Ping, X. Y. (1996). Chinese village women as visual anthropologists: A participatory approach to reaching policymakers. *Social Science & Medicine, 42*(10), 1391-1400.

Wang, C. C., & Burris, M. A. (1997). Photovoice: concept, methodology, and use for participatory needs assessment. *Health Education & Behavior, 24*(3), 369-387.

Wang, C. C., Cash, J. L., & Powers, L. S. (2000). Who knows the streets as well as the homeless? Promoting personal and community action through photovoice. *Health Promotion Practice, 1*(1), 81-89.

Williams, S., Sheffield, D., & Knibb, R. C. (2014). A snapshot of the lives of women with polycystic ovary syndrome: A photovoice investigation. *Journal of Health Psychology, 21*(6), 1170-1182.

Wilson, G., Jones, D., Schofield, P., & Martin, D. (2013). *The Use of the Sensecam to explore daily functioning of older adults with chronic pain*. Paper presented at the ACM Proceedings of the 4th International Sensecam and Pervasive Imaging conference.