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The potential of chest mounted action cameras in early childhood education research

Abstract

GoPro action cameras have become increasingly popular in TV, movie production, and in sports filming. In this article, GoPro action cameras are explored as a data collection tool in outdoor early childhood education research. Using GoPro action cameras in outdoor early childhood education research provides great possibilities. The cameras can provide researchers with natural data about children's interactions, play, and communication. The cameras function well under difficult outdoor conditions and provide the researcher with good sound and image quality. Ethical considerations are thoroughly discussed. Children's rights to privacy may be breached using these cameras. Informed consent is crucial, and professionalism, human knowledge, and tact are required. This study concludes that ethical considerations need thorough attention if these cameras are to be considered for use in research about children.

INTRODUCTION

Since the early 1920s, video documentation has been used in social science research (Walsh, Bakir, Lee, Chung, & Chung, 2007). The technological development has escalated, especially after digital technology made its appearance and new practices have emerged. Capturing, storing and sharing video is now quick and simple, and gives new opportunities in research (Derry et al., 2010). Video cameras are widely used to document everyday life and the material is often shared on the internet (Knoblauch, Schnettler, & Raab, 2006). The most common method in video research so far has been the use of digital cameras, either filming by hand or using a tripod.

In this article, we explore the use of action cameras in researching children in nature. Action cameras are small cameras often mounted on helmets, the chest or on devices filming extreme sports. Their size and many possibilities makes them interesting for use in research. Action cameras mounted on students have been tested in universities and secondary schools, and technological and ethical considerations have been brought up and discussed (Blikstad-Balas & Sørvik, 2015; Frøyland, Remmen, Mork, Ødegaard, & Christiansen, 2015). An action camera provides the participant's view, and is a good supplement to other video techniques. Furthermore, it provides the researcher with unique recordings, and a perspective that can easily be missed when using a handheld camera (Blikstad-Balas & Sørvik, 2015; Kindt, 2011; Frøyland, et al. 2015). Although these cameras are being used in research in schools, the use in early childhood education (ECE) research is yet to be explored. The advantages and disadvantages of conventional digital cameras are well documented in video research (Derry et al., 2010; Graue & Walsh, 1998; Walsh et al., 2007). Some important advantages are the great details provided by video, possibilities for revisiting data, easy storage and sharing, and data that are easy to code. Important disadvantages concern how to select and capture situations, the camera frame as a limitation, disturbance from the participants and ethical considerations (Derry et al., 2010; Graue & Walsh, 1998; Walsh et al., 2007). This article will discuss technical, practical and ethical aspects when using action cameras in ECE setting.

The action camera as a research tool in the learning sciences

Although an action camera is a relatively new data collection tool in research, some studies have been published. These studies have primarily tested the head-mounted camera as a data collection tool for understanding social life and experiences (Brown, Dilley & Marshall, 2008) and in learning sciences (Beddal-Hill & Raper, 2010; Blikstad-Balas & Sørvik, 2015; Frøyland et al., 2015; Kindt, 2011; Maltese, Balliet, & Riggs, 2013; McCaslin, Young, & Kesireddy, 2014; Remmen & Frøyland, 2014, 2015a, 2015b; Stolpe & Bjorklund, 2012). Although all of these studies used some form of action camera (head-mounted), two studies especially explored its use more thoroughly.

Brown et al. (2008) discuss the use of an action camera as a data collection tool in a social science context with cameras mounted on mountain bikers. The study points out that video representation is not a copy of the real world but an interpretation of the environment and therefore culturally constructed. This is important to bear in mind when footage from either action cameras or conventional cameras is analysed. When using action cameras, selection in the field is outsourced. However, the benefit of action cameras is that you get the participant's view of the situation. Brown et al. (2008) also points out ethical issues, the first being that confidentiality is difficult to ensure, and the second that anonymity may be difficult to protect. A head-mounted camera does not reveal the face of the wearer, but the voice and some of the body is visible. People who have not consented to be recorded might be present in the video.

Remmen and Frøyland (2014, 2015a, 2015b) have used action cameras extensively in classrooms and in fieldwork. These studies use action cameras mounted on teachers and students to collect data to analyse learning processes in geoscience in upper secondary school. Based on these Norwegian studies, Frøyland et al. (2015) review the use of head-mounted cameras on students. Head-mounted cameras made it possible to study social and physical actions. In practical activities, students move around both in classrooms and in the field. When a conventional camera records what seems to be a chaotic setting, the head-mounted camera gets more selective footage on what the students actually do. In all, the head-mounted camera makes interesting details visible without a researcher being present. Both communication between participants and actions in different places are recorded, and gives a good insight in each setting. In her doctoral thesis, Remmen (2014) points out that head-mounted cameras capture footage that would not have been captured with a handheld camera. Head mounted cameras also secure the visual perspective of students and teachers. Lastly, it also eliminates the disturbance caused by the presence of a teacher. Students also forget that the camera is on their head, recording everything they say and do.

The change of setting from a researcher filming with a handheld camera to a camera mounted on students gives a change in perspective. Using an action camera allows the researcher to share the perspective of the wearer (Brown et al., 2008). It is well suited to the investigation of practices when the researcher has limited access to the situation or if the subjects are highly mobile (Brown et al., 2008). It might be that the researcher gets new insight from the child's perspective when the camera is mounted on the child's chest.

With this in mind, it is interesting to investigate how action cameras function with children in ECE institutions in nature. The definition of nature is not obvious (Hessen 2008; Bergnéhr 2009). In an ECE setting it is common to distinguish between indoor and outdoor, and emphasize the benefits of outdoor play and learning (cf. White 2014). This distinction does not take into account what characterizes the outdoor environment. A more precise term would be to use the concept "natural world" as described by Chawla (2006) or natural environment described by Mawson (2014) as "the wild woods". In this study we understand nature as areas not constructed by humans. For example forests, lakes and rivers.

Approaches to video research

In social sciences, video is widely used to generate data for analysing what people do or how they interact in different settings. However, in learning sciences, these methodological discussions are underdeveloped (Knoblauch et al., 2006). In a Swedish review, Heikkila and Sahlström (2003) analysed thirteen PhD theses concerning video methodology. They found that the descriptions were vague and inconclusive, and state that descriptions of video methods should be more thorough. Since this topic is poorly discussed in the learning sciences, we will draw upon experiences from social science research in order to understand the effect of different methodological approaches and how people react when a camera is present. Researchers may learn from film directors when they use video recordings and direct the participants. Focus, camera movement, when to record, when not to record and selection in the situation, is key to the actual content, or the corpus of data for analysis (Knoblauch et al., 2006; Laurier & Philo, 2006; Mondada, 2006). In ECE research, we strive to get the footage as natural as possible without directing children and without the researcher disturbing the children. This is referred to as "natural data", meaning that the situation is affected as little as possible by the researcher (Knoblauch et al., 2006; Laurier & Philo, 2006; Mondada, 2006). The aim is that the people recorded act as unaffectedly as possible, although both camera and researcher are present. However, there is no doubt that the presence of technology will influence the situation (Knoblauch et al., 2006). Children tend to act and joke in front of the camera if the researcher uses a handheld camera, but ignore the camera if it is on a tripod (Graue & Walsh, 1998). The basic choice is between holding the camera and filming by hand, or place the camera on a tripod. Action cameras provide a third choice: to mount the camera on a student or a child. Whatever you choose, the choice will affect the data. In research these choices are not widely discussed, but often described. Frøyland et al. (2015) point out that the video design using cameras on tripods or handheld cameras is difficult to replicate in an outdoor science activity setting with students and teachers. Therefore, action cameras can be used to get footage that is more convenient. In ECE research, this aspect becomes applicable. Children's level of activity is high, and it might be difficult to keep track of the children outdoors.

The children's perspective

It is not easy to define 'children's perspective'. Halldén (2013) distinguish between 'children's standpoint', and 'children's perspective'. Whereas 'children's standpoint' can be understood as adults' intentions and interpretations of what children need and think, 'children's perspective' leads us to what the child actually sees and what actually appears as meaningful for the child (Halldén, 2003; Johansson, 2003). In our study, 'children's perspective' will be the basis for the discussion. Johansson (2003) says that children's perspective can be expressed through the child's behaviour, such as body language, mind-set, language, gestures and cadences and through the actual setting. She also writes about children's intentions and expressions of meaning. Children are always acting from their perspective no matter what they do (Samuelsson & Carlsson, 2008). As a prerequisite for understanding

children's perspective, it is important for the researcher to be aware of how children communicate their perspective (Samuelsson & Carlsson, 2008). Interactions must be on the children's terms, and the researcher's focus must be in the physical presence of the child (Johansson, 2003).

Ethics in video research

Derry et al. (2010) summarize the well-known basics of ethics in the learning sciences; informed consent, sufficient information, volunteerism and withdrawal without penalty. However, minor children are a vulnerable population (Derry et al., 2010). Any research aiming to use young children as participants directly poses ethical challenges (Robson, 2011) and both informed consent and protection of research respondents are problematic in research with children (Morrow & Richards, 1996). Robson (2011) addresses some key aspects regarding this. She states that some children may find it difficult to understand the concept of 'freedom of choice'. Do they understand what they agree to? Therefore, the researcher needs to make sure that informed consent is given in a way children understand. It might be wise to include opportunities for children to see themselves on video before giving consent (Robson, 2011). When involving small children in research, body language and gestures are important signals for researchers to interpret, and must be taken into consideration (Robson, 2011). Morrow & Richards (1996) underline that researchers may take children's participation for granted. They therefore emphasize the importance of respect for each individual child and for the group of children as a whole. Researchers are often engaged and want to get the best footage for research, and might do some harm by doing so. Respect is more than consent granted from adults – it follows the entire process from the first meeting with the children, through data analysis and to the day the paper is published (Morrow & Richards, 1996). Informed consent with children means that the researcher follows up the children and observes what they do. The researcher intervenes if there is a risk that compromising material is about to be filmed, hence the responsibility to protect the children (Morrow & Richards, 1996). Based on points above, it is clear that the researcher has a great responsibility when it comes to paying attention to children and their ways of communicating.

Ensuring anonymity in video research is not an easy task (Derry et al., 2010). Video recordings reveal details about children's identity both visually and through sound (Robson, 2011). There are techniques available to filter or mask the participants. However, this is expensive and there is a potential for compromising data (Derry et al., 2010). A more common approach is to restrict access to data (Derry et al., 2010; Robson, 2011). This is done by limiting access to the project data, ensuring it never will be published on the internet or social media and ensuring to delete the data at the end of the project (Robson, 2011). Both Derry et al. (2010) and Robson (2011) discuss how to ensure anonymity in a good way. Derry et al. (2010) also mention the possibility of sharing data online. However, in the literature, data security is yet to be discussed thoroughly.

Aim and research questions

In this study, we will explore and discuss the use of action cameras in outdoor early childhood education. The aim of this project is to explore and discuss the technical, practical and ethical aspects of using action cameras in research on children in nature. The research questions are:

- RQ1: What are the technical and practical advantages and disadvantages of using action cameras in outdoor ECE research in nature?
- RQ2: What challenges emerge when using handheld cameras and action cameras to collect natural data from children's perspective in outdoor ECE research in nature?

METHODS

In this part, we will describe the methodical approach. Selection of participants and ethical considerations will be presented before we describe our approach, data collection and analysis of data.

Selection of participants

The ECE institution selected for this study was chosen because of its reputation for being outdoors all day, every day and year-round. This ensured that we could collect data on several outdoor trips in various weather conditions and in different environments. The institution is a “nature kindergarten” and located in a hilly, forested area close to a small lake. Teachers and children can start their trips in nature right outside the fence. The institution had six employees - one male and one female preschool teacher, two male assistants and two female assistants. Both preschool teachers joined all trips in this study. The eighteen participating children were between three and six years of age and the gender balance was fifty-fifty. All children joined as one group.

It was important for us to test the cameras in authentic settings to make sure we could get reliable experiences and results, hence the selection of a nature kindergarten where activities in nature were part of everyday life and independent of weather conditions. This strengthens the study’s validity in terms of the cameras being tested in natural outdoor ECE settings.

Ethical considerations

The Norwegian Centre for Research Data (NSD) approved the project and all parents and staff signed an NSD-approved consent form. We arranged an introduction evening in the ECE institution to meet parents and staff to present our research project and to answer questions. All parents and staff gave their consent. Staff, children and parents could withdraw from the project at any time without giving any reason. The staff prepared the children before we introduced them to the cameras and the project on the first day of data collection. This preparation included telling the children that two adults would join their trip, and that it would be filmed with both handheld cameras and chest-mounted action cameras. The children were asked if they wanted to wear the camera and we assured them that they could take it off at any time without giving a reason or needing to explain. If a child did not want to wear the camera, it was taken off. They were also told what the video footage was going to be used for. We intended to ensure an informed consent from the children. These children were accustomed to being filmed by staff, but it can be discussed whether all the children really understood the implications of what they were about to take part in. In consideration to the power imbalance between the children and us, we put a lot of effort into being sensitive to the children’s needs and opinions and to read the children’s body language. The children wearing the cameras were randomly selected on the spot. We did not want to put any pressure on the children to wear the camera.

Methodological approach and research design

We were two researchers in the field conducting data collection with both handheld and action cameras. Both were equally responsible for filming and handling the action camera equipment. We did not hypothesize for any results, but rather wanted to start from scratch and let the situations, issues and possibilities emerge. Using an unstructured observation approach (Christoffersen & Johannessen, 2012), we were generating a large amount of data from the handheld cameras and the criteria for selection were:

- Any situation we observed where children were wearing an action camera, gathered around something or someone
- Any situations we observed where the children were wearing an action camera engaged in physical activity play like skiing, climbing, swimming, jumping, balancing etc.
- Any situation where the preschool teacher or assistant initiated gatherings, explorations or teaching sessions.
- Any situations we observed where children wearing an action camera was occupied in play or exploration, or called for an adult to support their play or exploration.

One of the main advantages of this approach is when researching a new field one needs to have an open mind to be receptive for new knowledge and insights. Not knowing or hypothesizing the results leaves us to explore unbroken territory, thus allowing for new knowledge. In the coming analysis we will refer to this as emerging findings and the criteria above are related to answering RQ2.

What is a GoPro action camera?

A GoPro action camera is a small and lightweight video and photo camera that can be mounted on a person's body, on equipment, on tripods or on other structures. We chose GoPro because it was the first of this type of cameras on the market and because it had most accessories available at the time. The first GoPro camera was launched in 2004, and has gained enormous popularity in TV productions, movie productions and among extreme sport athletes, outdoor people and others wanting to capture their actions and experiences. GoPro has been the leading brand when it comes to versatility. GoPro action cameras can be mounted on a person's head or chest using a strap or harness, on helmets, skis, hands, poles, bicycle handlebars, brackets, straps or clips to mention some of the mounting possibilities. The cameras can be mounted with a waterproof housing, making it possible to use in almost any situation, weather condition and environment. This versatility triggered our curiosity for the possibility of using them in researching children's actions, behaviour, exploration and play in nature.

Since this research started, GoPro has developed a number of new models, features and a drone carrying a camera. This development does not, in our view, outdate our research, but rather underline that these types of cameras has both tremendous possibilities and give us serious ethical challenges that will even increase with further technological development.

We used GoPro Hero 3 Black in our research. In this study, we mounted GoPro action cameras on children in an outdoor ECE institution in Norway. We mounted the cameras with a chest harness in order to capture situations from the children's perspective. We considered using a head mount, but realized that this might restrict and influence the children's mobility considering the weight added to a child's head. Small children already have a high centre of gravity and a camera would only add to this and could contribute to an increase in imbalance for the child. The camera weighs 338 grams including a head strap. A chest harness was considered less restrictive and less interfering than a head mount. We used GoPro's Chesty Kids designed for children. The memory card capacity was 32GB at HD1080 recording, equivalent to 2 hour 15 minutes recording time. The camera supports 64GB memory card according to the manual. We used the standard battery.

The fieldwork

Before starting our recordings, the children were introduced to both handheld and action cameras. We decided to satisfy their curiosity by letting them play with and get used to the action cameras for 30 minutes before pressing record on our first day out. We did this to reduce the amount of tampering or fingering that we assumed could interfere with our recordings. They were told not to worry about breaking the cameras and to play and act as they used to. The cameras were then set to record and the trip started.

We joined the preschool on four trips. Totally, we collected 35 hours of video, of these 22 hours came from GoPro. See table 1, 2 and 3 for details on each trip. During all four trips the cameras were initially worn by two or three children (table 1), but on every trip the cameras were put on new children two or three times. When a child did not want to wear the camera anymore, it was taken off and a new child was asked.

Table 1: Data collection details

| Time of year | Number of children/ adults | Number of Cameras | Distance of trip | Weather conditions | Topic of the day |
|--------------|----------------------------|-----------------------|--|------------------------------------|-------------------------------|
| September | 18/4 | 2 GoPro 2 handheld | Approx. 2 kilometres | Sun and partially clouded. Warm | Climbing Picking mushrooms |
| November | 17/4 | 3 GoPro 2 handheld | Approx. 2 kilometres | Cloudy and wet | Geology Storytelling |
| February | 17/4 | 3 GoPro 2 handheld | Depends on each child's activity level | Cold, snowy and windy | Cross country skiing |
| June | 18/4 | 3 GoPro 2 handheld | Approx. 1 kilometre | Sunny and warm | Science Swimming |

Table 2: Descriptions of trip and terrain

| Time of year | Description of trip | Description of terrain |
|--------------|---|---|
| September | The group was slowly on the move but stopping in areas with mushrooms and at climbable boulder, rock formations and trees. | Forested area with spruce. Partially steep terrain with climbable boulder, rock formations and trees. Some paths. |
| November | The group was slowly on the move exploring rocks. An opencast mine was the target for the day. | Forested area with spruce. Steep and partially rough terrain. Some paths. |
| February | Unorganized play on skis in close proximity of the institution. | Snow covered open and hilly terrain. Partially prepared for skiing, ski jumping and play. |
| June | Walking down a creek, exploring stones, insects and plant life. Jumping in pools and swimming/drifted in slow moving water. Children were wearing wet suits, shoes and lifejackets. | Creek with both shallow, rocky bottom, and deep pools in marsh. |

Table 3: GoPro camera on children and changes during trip

| Time of year | Number of GoPro camera | Number of children wearing camera during trip (of tot.) | Number of changes |
|--------------|------------------------|---|-------------------|
| September | 2 | 5 (18) | 3 |
| November | 3 | 8 (17) | 5 |
| February | 3 | 7 (17) | 4 |
| June | 3 | 3 (18) | 0 |

Logging and analysing data

Through analysis, the aim was to reveal advantages and disadvantages using GoPro camera through these criteria:

- Technical: Sound and image quality, battery and memory card capacity, physical size of camera, harness functionality, robustness of the camera. (RQ1)
- Practical (Situations captured on GoPro cameras): Situations not captured on handheld cameras, conversations between children and teachers, conversations between children and child-initiated activities and play. (RQ1)
- Ethical: Situations with ethical challenges from GoPro cameras (RQ2)

When logging, each camera was given a name, such as “GoPro 1” and “handheld 2”, when we went through the footage from each camera. All video was imported and saved using Final Cut Pro software and coded in an Excel file. We started with our observations through handheld cameras, and made notes in the Excel file of any situation that matched our criteria. The same procedure was done for GoPro cameras. This system made it easy to find any situation on a given day and on any camera. Some situations were captured on several cameras and we could view the situation from different perspectives, angles and distances.

FINDINGS

We have chosen to divide our findings into three different categories:

Findings related to RQ1:

1. Technical and practical advantages and disadvantages related to findings unique to the GoPro camera. For each advantage/disadvantage we present the observations the finding is based on, and which criteria the observation is based on.

Findings related to RQ2:

2. Emerging findings from handheld camera are based on observations and field experiences unique to the use of handheld camera.
3. Through emerging ethical findings, we present some observations that cause some ethical dilemmas.

1. Technical and practical advantages and disadvantages

The advantages using GoPro camera is presented in table 4 and disadvantages in table 5.

Table 4: Technical and practical advantages using GoPro camera

| Advantages | Observation | Criteria |
|--|--|---|
| Camera is compact and harness does not restrict children’s movement | The camera sits steady on the children’s chest and does not restrict movement. No complaints from children about wearing the harness. | Technical results: The physical size of the camera. Harness functionality. |
| Camera is robust and handles a great deal of beating | The camera was tested in winter, in water, while climbing and in children’s play. It was never any problem with the functionality. Camera was never accidentally shut down or stopped working due to physical impact or tampering. | Technical and practical results: Robustness of the camera |
| Good clear image | All our data showed a very good image quality. We did not have any problems seeing details in different situations | Technical results: Image quality |

| | | |
|---|--|-------------------------------------|
| Good sound quality | We could hear conversation in the near presence, even with water tight housing. With open back plate, it is even better sound quality. | Technical results: Sound quality |
| The children forget the camera | We observed the situations where the camera was put on, and when we changed to a new child. The first 3-5 minutes it is some awareness, but they forgot the camera especially when a new setting arose. See table 3 | Emerging results |
| Filming from the child's perspective | We got several recordings unique to GoPro camera from situations we did not observe with hand held camera. These recordings were close to the situation, we heard the conversation between the children and between children and teacher, and we saw clearly what the children did with their hands. | Emerging results |

We have chosen two situations to exemplify these findings.

Example 1: Image quality and sound quality

On the September trip, a five-year-old girl wore a camera and was handed a whittling knife from an adult to rinse and cut mushrooms. In this recording, we could easily hear the conversation between the adult (one meter away) and the girl on how to use the knife and how she was corrected when cutting towards her leg. When she started cutting we could easily see her hands, what she was holding (she held both a bundle of leaves and the mushrooms in one hand while cutting the mushroom with the knife), how she cut and what she was saying. The wide-angle lens gave us a clear view of this although her hands were only about 15 cm from the camera. Her rubber rain clothes made some structural noise but not enough to drown out the conversation.

Example 2: Filming from the child's perspective, unique to GoPro recordings

On the September trip, a 6-year-old girl wore a camera when exploring on her own while the group was slowly on the move. Sitting down on a log, she pounded on the bark, identifying that it was hollow before she ripped the bark off and shouting: "Ole! There are a lot of animals here!" She had discovered a number of snails underneath the bark, initiating a conversation with one of the adults. In this situation, the camera recorded the girl's exploration, her way of testing the environment and how she called for an adult to support her in her exploration. When Ole reached her, we also recorded how he tried to support her curiosity. While she was more occupied with giving the snails human qualities, Ole was more directed towards providing scientific guidance on species or classification.

Table 5: Technical and practical disadvantages using GoPro Camera

| Disadvantages | Observation | Criteria |
|--|---|---|
| Battery capacity | Changed battery once during each trip. | Technical results: Battery capacity |
| Sound interference from clothing | We heard some structural noise from clothing. | Technical results: Sound quality |
| Memory card capacity | 2h 15m recording time with 32GB memory card. End of session. | Technical results: Memory card capacity |
| Camera as a part of children's play | It was some degree of playing with the camera, but mainly in situations where camera was put on in the beginning or changed during the trip. No situations was spoiled while filming important situations | Emerging results |

2. Emerging findings with handheld camera

One important finding was due to the presence of the researcher with a handheld camera. Recording from distance did not disturb the situation, but to get details of what the children did and said, we needed to get closer. Our experiences with using handheld cameras in this study is that once we came close to film a chosen situation, the children became interested in us and the camera, and aborted the play and exploration they were a part of. In several situations, children stopped the activity, drew their attention to the researcher and the camera, and the “magic” of the situation disappeared.

3. Emerging ethical findings

To exemplify emerging ethical challenges, we will refer to three situations we discovered in our analysis. These three situations give some aspects to ethical consideration, and all show situations where the children are alone without any adult paying attention. These three examples of children being alone with the camera tell us that, given this setting with 18 children, we did not have 100% control over the cameras and what was recorded.

The first example is one girl, five years old, going to toilet alone. We see that she walks away from the others, and we hear the sound of pee. No nudity was exposed.

The second example is one boy going into the wood alone and talking to himself. We can see what he is doing, what he is talking to himself about and we get an insight in his thoughts through his conversation.

The third example show some interesting social interactions between three girls aged 5. One of the girls has a GoPro camera, recording the conversation. Apparently, two of the girls do not want to be together with the third girl and freezes her out. It’s a sad scene and they are not aware it is recorded.

DISCUSSIONS

An action camera differs a lot from a conventional video camera, and these significant differences challenges the researcher regarding ethical issues but also facilitate great opportunities to collect data in an outdoor setting.

Technical and practical advantages and disadvantages

Our findings show us that a GoPro action camera is a reliable tool for collecting video data in an outdoor ECE setting. The camera provides good quality sound and images, and can take a lot of beating. Example 1 showed that action cameras could give us clear images and good quality sound even in a close situation. The camera provided good quality documentation of the situation.

The disadvantages are manageable but the camera’s battery capacity is somewhat limited. To maintain the compact profile of the camera, we could not add a bigger battery. This would make the rig bulkier and it would not fit as snugly using the chest harness. We had to change the battery in every camera once a day during each trip. This interrupted the ongoing recording and we probably missed some interesting situations. When children were aware of the camera giving a sound indicating shutting down, they came to us thereby stopping what they were doing. In this period, we therefore had a gap in the recordings. However, for shorter periods of recording, battery capacity was not a constraint. New GoPro camera models are now launched and may have better battery capacity. An action camera gives the researcher less control over technical challenges due to the inherent possibility to stay at a distance. Staying at a distance means the researcher might experience loss of data due to technical issues like the battery running out. The recordings stopped after 2 hours and 15 minutes due to a full 32 GB memory card. A bigger memory card or using a lower recording resolution can solve this issue. In this study, we have seen that the technical disadvantages are manageable if the researcher is aware of them and is observant during fieldwork.

Significant practical advantages make action cameras very interesting to consider when doing in-depth studies and research outdoors in an ECE setting. Firstly, our study shows that the children quickly forgot that they were wearing a camera. This might be because of the compact feature of the camera and that the harness did not constrict the children's movements. Similar findings have been echoed by Remmen (2014) and Frøyland et al. (2015) where the older students forgot the camera after a while. After a few minutes, the children were immersed in playing, exploring and interacting. One explanation for this might be that all the possibilities for play and exploration in nature quickly caught their attention. This gives the researcher an opportunity to get up close, film actions and record conversations without having to be in close proximity of the children. We recorded what the children were doing and saying in a natural setting, undisturbed by the researcher or other adults. In short, we came very close without influencing the situation with our presence. We were able to record situations, conversations and actions from the child's perspective in a situation created by the children themselves. The situation in example 2 was not recorded by a handheld camera by any researcher. We would have missed this situation entirely if the girl had not been wearing a camera. The camera documented a researcher-uninfluenced situation from a child's perspective. For conversation only, a sound recording could be sufficient and we encounter less ethical considerations. However, to get the child's perspective and a full understanding of the situation, what this girl does with her hands is crucial to interpret the conversation in context. This kind of documentation will increase the validity of a study aiming for an in-depth view of children's culture, play, actions and interactions. This shows us how valuable action cameras can be either alone or in addition to observation or a handheld camera in outdoor research. However, using a handheld camera up close can disrupt the situation.

The practical disadvantages are few, but needs to be addressed and taken into consideration. Firstly, it is obvious that a camera mounted on the chest, close to arms and hands, might lead to some tampering by the children. However, we found that the children did not shut off the camera, either on purpose or by accident. Secondly, a fair amount of noise comes from the wearer's clothing rubbing against the camera housing. Being outdoors in fall or winter or during bad weather means wearing more noise-generating clothes like nylon, Gore-Tex or other rainwear. The worst case is that the clothing noise can drown out speech and conversations, thus stealing important data from the situation. Thirdly, the camera, mostly right after being put on a new child, could become a part of the children's play. This usually happens just after it is put on a child for the first time. The child might shout out things like *"Hey, I am filming you!"* while pointing her chest at another child. However, the impact of such moments was limited because after a few minutes the children again became occupied by playing and exploring. Again, any interruption in recording will reduce the amount of natural data material. Knowing the technical and practical interruptions possible, it is obvious that the researcher, although able to stay in the background, must be on guard and observant to keep loss of data due to interruptions at a minimum. The researcher must know the camera well: how to change the battery, how to clip the harness on and off and how to adjust any recording setting in case a camera has been tampered with. This will in turn reduce the amount of time the camera is not recording and it will reduce the time the camera potentially will be a part of the children's play. The greater the number of cameras and participants, the more demanding the practical issues will be for the researcher.

Ethical considerations

When using video in research with children, researchers must behave respectfully and be sensitive to children's reactions. The power relationship between children and adults is asymmetrical and it gives the researcher great responsibilities. Graue and Walsh (1998) have said the following on this topic:

"In relationships between adults and children, adults are most often the knowledge holders, the permission granters, and the rule setters. In research with children, children are the knowledge holders, the permission granters, and the rule setters – for adults. Research with children turns part of the world upside down. The adult researcher who goes to another adult and asks that person to be her teacher is doing something she has done many times before – adults teach other adults all the time. In our culture, children do not teach adults. They may manipulate adults, but they typically do so within a context where the adult is putatively in charge. The researcher who works with children must carefully consider what it means to work in this upside-down world" (Graue & Walsh, 1998, pp. 56-57)

It is easy to take children's participation for granted and forget the basics of respect for each individual and the group of children as a whole. In research with children, both informed consent and protection of research respondents are problematic (Morrow & Richards, 1996). The researcher must consider intervening if a development in the project requires action to ensure the children's privacy. However, use of cameras mounted on the chest of the children poses some new ethical dilemmas. The actual location of the camera poses the most interesting aspect in ethics. The camera is located within the children's private sphere and record uninterruptedly everything the child says and does. The ethical concern is that the child becomes unaware of the camera and cannot choose whether to be filmed or not in a private and potentially vulnerable situation, hence the problem with children and their freedom of choice (Robson, 2011). Adults generally have a fuller understanding of the setting they are filmed in and can give their deliberate consent.

The ethical implications of the findings in this study are significant and unique to GoPro action cameras. The children forget that they are wearing the camera so that all private situations are recorded: conversations, speaking aloud to oneself, discussions and secrets told to other children. It is therefore up for discussion whether we have a true informed consent from the children. Do they really understand the implications of what they are a part of and that all they do will be seen and analysed by the researcher? Since the children forget the camera, they also forget, or do not understand that all they say and do is recorded and will be viewed by the researchers. This is the twin-edged sword of using these cameras; we get up-close, but we also enter the children's private sphere without them fully knowing. A child's right to privacy is breached when the child is not aware of, or is not expected to understand the implications of wearing this camera. We cannot expect a child to understand the implications of wearing a camera when we know that they forget that they are wearing one. This is borderline hidden surveillance and leaves us with great issues when conducting research using action cameras. In social science, all but the toilet episode might be interesting to analyse in the context of social interaction between children. GoPro action cameras gave us insight in situations from children's perspective without researchers present. All this taken in to consideration, video data involving children is sensitive, and with action cameras even more sensitive. At the same time, the data generated is valuable in research. We will emphasize the importance of limiting access to video data only to researchers in the project (Robson, 2011) and keeping data on a secure server. We will not recommend the use of these cameras as a tool for ECE teachers to document children's everyday life and interactions unless ethical issues are thoroughly discussed and teachers are in immediate presence to be able to intervene if recordings are documenting unwanted situations. We consider data generated too sensitive to record if children are left alone.

CONCLUSION

RQ1: What are the technical and practical advantages and disadvantages of using action cameras in outdoor ECE research in nature?

GoPro cameras are robust and provide good quality sound and video recordings of what children are doing and saying, both close to the camera and within close proximity of the child. To prevent technical issues, loss of potential valuable recording time due to improper configurations, it is important to know the camera settings and equipment well and the limitations in battery and memory card capacity. GoPro action cameras can provide natural data from a child's perspective. To prevent practical issues, the researcher must be aware of the possibility of the camera becoming a part of children's play, and therefore make time for the children to get to know the camera.

RQ2: What challenges emerge when using handheld cameras and action cameras to collect natural data from children's perspective in outdoor ECE research in nature?

Using GoPro in outdoor ECE research provides great opportunities to collect natural data from the children's perspective, either on its own or as a supplement to handheld video camera and observation, but handheld cameras pose some challenges when approaching a situation. The handheld cam-

era and the researcher may interfere in the situation. Mounted on a child, an action camera provides the opportunity to record children's actions, interactions, exploration and conversations without interference from the researchers. But, ethical considerations are, in our opinion, the main challenge when using action cameras to research early childhood. Although using an action camera provides great opportunities, it also challenges the researcher's professionalism, human knowledge and tact. The children's way of communicating, expressing themselves and using subtle body language must be taken into consideration. Key aspects are that children forget they are wearing the camera, that all actions and conversations are recorded – even those we don't see – and that we cannot expect the children to understand what they are consenting to. Therefore, the researcher must consider intervening in the recording to protect the child. True informed consent is crucial to ensure the children's rights and needs in this kind of research, and limiting access to data is most necessary.

Further research and possibilities

Using action cameras in ECE research might give researchers a deeper insight into how children act, play, explore and interact when adults are not present. We might gain new knowledge that can improve how early childhood teachers plan and organize outdoor activities, play and teaching. Using the wearable camera as a supplement to observations and video recordings might strengthen a qualitative study due to triangulation and a broader data collection. Ethical issues must be a central component when designing a study, and continuing technical developments will probably make this need even more apparent.

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