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Exploring the Potential Impact of Body Worn Cameras on Memory in Officer-Involved Critical Incidents: a Literature Review

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Abstract
The current paper reviews existing literature that relates to how body worn cameras might influence an officer's memory of their interactions with the public, namely those that involve the use of force. Notably, most of this research does not come from the policing field but focuses on the impact of camera technology in other settings. Much of the available research supports the commonly held view that body worn cameras could be used to enhance memory for these interactions, particularly interactions that are complex or stressful. However, contrary to what people might expect, research also exists that suggests body worn cameras may actually have a detrimental effect on officer memory. Three major potential detriments: cognitive offloading, retrieval-induced forgetting and misinformation-type effects are highlighted. Future studies examining the impact of body worn cameras on officers' memory are necessary. Ways forward are discussed.

Keywords Police · Body worn cameras · Memory · Offloading · Misinformation · Use of force

On June 25th, 2016, two members of the Fresno Police Department shot and killed 19-year-old Dylan Noble (Hamilton and Winton 2016). Noble was suspected of carrying a rifle, and did not comply with police instructions; unfortunately, it was not until after the police opened fire that it became apparent that Noble was unarmed. The Fresno shooting is only one case in a succession of controversial use-of-force (UoF) incidents that have occurred in recent years, such as the 2013 fatal shootings of Sammy Yatim in Toronto, Ontario (Loriggio 2016) and that of Michael Brown in Ferguson, Missouri in 2014 (British Broadcasting Corporation 2015). Consequently, there has been growing, widespread public criticism of police decision-making and performance (Hansford 2019; Kleinig 2016), culminating in protests (Hamilton and Winton 2016), allegations of police brutality (Hamilton and Winton 2017; Smith 2018), and even deadly attacks, including the sniper attack in Dallas, Texas, in 2016 (Karimi et al. 2016).

Many police agencies are now using body worn cameras (BWCs) as a way to improve police-public encounters, and subsequently instill confidence and trust in policing (Jennings et al. 2014). Not only might BWCs positively influence how the police and the public act, by potentially encouraging more respectful interactions (Ariel et al. 2015), this technology might also allow the police and the public to more fully understand what transpired during police-public encounters. One mechanism by which BWCs might do this is by facilitating an officer's ability to recall details of their encounters, such as *what* transpired during the incident, including aspects of their risk assessment, which speak to *why* they made the decisions they did (Dawes et al. 2015). If viewing BWC footage can enhance an officer's memory for a UoF encounter, this may assist the officer in a variety of contexts (e.g. preparing their report about the encounter, when being questioned during internal investigations, or when testifying about the incident in court).

The current paper reviews the literature to date, which speaks to how BWCs might influence an officer's memory of their interactions with the public. Notably, most of this research does not come from the policing field but focuses on the impact of camera technology in other settings. Much of the available research supports the commonly held view that BWCs could be used to enhance memory for these interactions, particularly interactions that are complex or stressful. However, contrary to expectations, research also exists that suggests BWCs may actually have a detrimental effect on officer memory. Both types of potential memory effects (i.e. positive and negative) will be reviewed in this paper. For the most part, we will focus our discussions on interactions with the public that involve UoF by the police. While these are not

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the only type of incidents where BWCs may have value, the discussion of BWCs often takes place within the context of such cases (Ariel et al. 2015; Farrar and Ariel 2013; Sullivan and Marrero 2016).

The Case for Body Worn Cameras

BWCs are small audio/video recording devices that can be mounted on an individual's clothing as 'wearable' cameras (Jennings et al. 2014), or attached to eyewear, collars, an epaulette, ball caps or helmets (TASER International Inc. 2015). The recordings are temporarily stored on the device before being transferred to a storage system (Freund 2015). Some of the more sophisticated BWC models are weatherproof, can store up to 70 h of footage, and are encrypted to prevent privacy leaks (TASER International Inc. 2015). Typically, officers are responsible for turning the BWC on prior to interacting with a citizen, and then off again afterwards to preserve battery life and recording space (Freund 2015). However, some recent models (e.g. Axon Flex 2) have been redesigned with the capacity to detect changes in the environment, such as the opening of car doors, which automatically initiates recording (TASER International Inc. 2015).

The earliest reported use of BWCs in a police force was in 2005 by the Cornwall Police Department in the United Kingdom (U.K.; Findlay 2017). Their primary goal in using BWCs was to improve the collection of evidence in domestic violence cases. By 2016, nearly half (47%) of all police departments in the United States (U.S.) had acquired BWCs, and many other police services were evaluating their possible use (Freund 2015; Hyland 2018). The majority of agencies who acquired BWCs have fully deployed them and developed formal BWC policy (Hyland 2018). In the U.K., more than 70% of police forces have BWCs, with the rest to follow suit in 2019 (College of Policing 2017; Coudert et al. 2015; Privacy International 2019; The Economist 2018). Currently in Canada, many agencies (e.g. Toronto, Thunder Bay, Durham) continue to pilot BWCs, but relatively few have fully implemented them (Findlay 2017; Ling 2019; Rosen 2019). Increasingly, conversations are turning to the need for cost-benefit analyses, in order for police services to decide whether or not to roll out BWCs, especially in Canada (Bud 2016; Saulnier 2019).[1]

In a large agency, front-end costs to purchase BWCs to equip all officers can be substantial (Police Executive Research Forum 2018). Then, there are ongoing costs to store and manage the videos following the initial expenditure (Thunder Bay Police Service 2019; Toronto Police Service 2016). Cloud-based technology is currently being considered by some agencies as a means to alleviate costs of storage and data management. However, there may also be hidden cost-savings to BWCs. Dawes et al. (2015) note that BWCs help provide compelling evidence which may promote earlier guilty pleas. For example, BWC footage can make it difficult for civilians to argue that they were not driving under the influence if the interaction is caught on tape. Less time spent by prosecutors and officers on cases like these may result in notable cost-savings. In fact, a pilot study by Goodall (2007) saw a time savings of 20 min per officer per 9-h shift with the introduction of BWCs. This increased efficiency is likely to have some positive financial implications over the long-term.

The fiscal consequences associated with BWCs must be considered alongside others, such as their effect on community relations. Indeed, as highlighted above, it has been argued that the presence of BWCs will reduce the opacity surrounding policing and subsequently improve officer accountability (Jennings et al. 2014). Some advocate, for instance, that BWCs will reduce police misconduct and ensure interactions between officers and citizens are fair. Several studies have corroborated such arguments, finding that officers who wear BWCs are involved in significantly fewer UoF incidents (Ariel et al. 2015; Farrar and Ariel 2013; Jennings et al. 2014; Mesa Police Department 2013; Sullivan and Marrero 2016). Notably however, others have failed to find support for this effect (Ariel et al. 2016a; Edmonton Police Service 2015; Grossmith et al. 2015; Hedberg et al. 2016; White 2014; Yokum et al. 2017).

It has been further argued that BWCs may reduce false claims of police misconduct and allegations of excessive UoF (Ariel et al. 2015, 2016a; 2016b; Freund 2015), as well as provide an additional perspective of events, beyond that captured by bystander via camera phones. For example, while the aforementioned Fresno shooting was originally caught on tape by a bystander, the officer's BWC also recorded the event (Hamilton and Winton 2016). When the bystander's video was shared publicly, the officers received extensive backlash as many citizens viewed the event as a gross misuse of force (Almasy and Moshtaghian 2016; Hamilton and Winton 2016). However, the police agency later released the officer's footage; providing the public with a different perspective, and perhaps for some, a different interpretation of the event.

Potential Benefits of Body Worn Cameras for Memory

Of particular value for police departments is the use of BWCs as a potential memory aide. Whenever an officer uses force, they are required to articulate their reason for doing so.

[1] Given the first use of BWCs in the U.K. and their current popularity in North America, we felt it pertinent to contextualize our review within the broader international community. However, we acknowledge that each country (and the various factions of law enforcement within each country) have different sets of policies and procedures dictating BWC use. While some portions of our review may not be applicable for all agencies given these differences, many of the cognitive concerns discussed are general enough to be widely relevant.

Although there is no standardized reporting procedure in Canada (Laming 2017) or the U.S. (National Institute of Justice 2016), most agencies require officers to explain what happened via some type of report. The Royal Canadian Mounted Police (RCMP), for instance, asks all officers to complete an electronic Subject Behaviour/Officer Response (SB/OR) report after each UoF incident (RCMP 2014). The information may be scrutinized by oversight bodies including command staff, the courts, and the media if obtained via an Access to Information and Privacy request. It is thus pertinent that officers provide the most complete and accurate report possible of what transpired. It has been argued that allowing officers to watch their BWC footage before writing their statement could enhance recall in such statements (PERF 2014).

There is, for instance, a long tradition of research showing that that visual imagery (static and dynamic) can enhance memory (Ally and Budson 2006; Aschermann et al. 1998; Houts et al. 1998; Ishai et al. 2002; Jack et al. 2015). Pictures are often shown to eyewitnesses to cue recognition memory (e.g. is what you are currently seeing the same as a previously witnessed person of interest?; Jack et al. 2015), props or scale models may be provided in court to elicit recall (Gordon et al. 1993; Salmon et al. 1995), and visual retrieval aids during interviews (e.g. like the cognitive interview; Geiselman et al. 1985) can be used to remember more than one otherwise would (Aschermann et al. 1998; Matsuo and Miura 2017; Vrij et al. 2018). In fact, according to Tulving's (1983) 'encoding specificity principle', memory retrieval is enhanced when the retrieval environment is similar to the environment in which the encoding took place. In other words, visual cues that overlap with the features of a to-be-remembered event are advantageous for memory.

Research from Outside Policing

There is a growing body of literature outside of the policing context that is finding significant improvements in memory with the use of BWC technology, mainly for autobiographical events. For example, Hodges et al. (2011) investigated the effects of SenseCam, a wearable camera, on memory of daily events. SenseCam is one of a growing list of devices colloquially referred to as a 'lifelogging technology' (Kalnikaite et al. 2010). Lifelogging is the phenomena of capturing daily life, to have a record of the places and people visited. SenseCam works much like a disjointed BWC. It is worn around one's neck, hanging at mid-chest level, and does not require user-intervention once turned on. However, instead of a continual video recording, the SenseCam produces a 'flipbook' of photographs. Every 30 s, the SenseCam automatically snaps a picture and it snaps additional pictures when it 'senses' a change in the environment. Its microprocessor is designed to detect various changes in the environment, similar to some of the more advanced BWCs. Moving from a light to dark room, or a person moving in front of the camera, are incidents that might trigger the SenseCam to take an additional photograph. Depending on how long the device is worn, thousands of images may be taken.

The original inspiration for SenseCam was for it to be a "human black box recorder" (Hodges et al. 2011, p. 3). However, its utility for individuals with severe memory impairment was quickly recognized. Clinical trials demonstrated that after reviewing images produced by SenseCam, amnesic patients could describe thoughts, feelings, and happenings associated with the images, but not depicted in the images per se (Berry et al. 2007; Hodges et al. 2006; Hodges et al. 2011). Follow-up tests with specific patients revealed that even when the images had not been reviewed for months at a time, the events associated with them could still be recalled (Berry et al. 2007; Hodges et al. 2006).

Anecdotally, healthy individuals have also reported that reviewing images produced by SenseCam enhances memory for incidents they otherwise forgot (Silva et al. 2013). Interestingly, when functional magnetic resonance imaging (fMRI) was employed with both amnesic and healthy individuals to examine the potential neurological changes occurring when one reviewed the images, regions of the brain involved in autobiographical memory were activated (Berry et al. 2007, 2009; Loveday and Conway 2011). Advocates of SenseCam argue that the device acts as a powerful cue, reinforcing "… consolidation of the episode into a retrievable long-term memory store" (Hodges et al. 2011, p. 695).

It is unclear why SenseCam appears to improve memory, at least in the limited studies that have investigated it (Berry et al. 2007, 2009; Browne et al. 2011; Hodges et al. 2006, 2011; Kalnikaite et al. 2010; Silva et al., 2018). However, because the camera produces such a detailed inventory of events, at least one of the images of a to-be-remembered event was likely captured during a moment of encoding. Hodges et al. (2011) argue that subsequent review of that event may then trigger recall. On the other hand, the very nature of the footage may imitate autobiographical memory. SenseCam images are short slices of experience, temporally ordered, and produced outside of one's awareness. Some research suggests that memory is mediated by visual images (Brewer and Sampaio 2006; Conway 2009), and recall, being a reconstructive process, relies heavily on visual cues, like those produced by the SenseCam (Kalnikaite et al. 2010).

Another possible explanation for the memory-enhancing effect of this wearable technology could relate to the way in which some lifelogging technologies cluster the hundreds of images produced into meaningful categories (Kalnikaite et al. 2010). This technique may aid the memory archiving process by expanding one's network of understanding about a particular topic (Anderson 1983; Collins and Quillian 1969). Some scholars argue that knowledge structures within one's memory can be understood as configurations of nodes that are linked

together by associations, broadly referred to as 'associative network models' (Anderson 1983; Collins and Quillian 1969). Information about a particular topic is held at one node, and as related information is acquired, associative pathways are created, giving way to a cognitive representation of a person, event, or situation. A picture produced by the SenseCam may thus cue an initial memory, and the hundreds of related pictures provide additional cues which one can use to associate and build other memories from. Alternatively, because the SenseCam is triggered by changes in the environment, the photos taken following a change in the environment may correspond to goal sequences that the brain encodes as an episodic memory: "That is, episodic memories may be formed at goal junctions...[and] the detection of changes in the wearer's activity and in their environment through onboard sensors could cause the SenseCam to trigger at junctions of goal processing" (Hodges et al. 2011, p. 11).

BWCs are, in themselves, a type of lifelogging technology. The only substantial difference is that rather than producing a store of photographs, BWCs result in a videoed record of the event. Since they too capture experiences in the temporal order that they occurred, potentially outside one's awareness, that can be observed later, it may be argued that BWCs also act like an artificial extension of autobiographical memory; or at the very least, a depository of rich visual images that can cue memory. In contexts outside of policing where BWCs have been used, research suggests that BWCs are useful for enhancing episodic memory. Hoisko (2003), for example, explored the use of cameras as a 'memory prosthesis', and found that image and audio data helped individuals recall additional facts about a recorded incident (p. 210). Similarly, Silva et al.' (2018) systematic review found that wearable cameras appear to be a beneficial memory rehabilitation technique, particularly if they evoke "more than a mere familiarity with previous stimuli… [but also] reinstate previous thoughts, feelings, and sensory information…" (p. 117).

Research Related to Policing

While this research suggests that there may be some value in BWCs in terms of memory enhancement potential, unfortunately, very little attention has been paid to the memory-enhancing potential of BWCs in the police setting. Indeed, as far as we are aware, Dawes et al.'s (2015) study is the only empirical study to date that has examined this issue. They equipped 11 law enforcement officers in the U.S. with a BWC and had them take part in three simulated UoF training scenarios. After the scenarios, the officers completed a UoF report on one of the scenarios. Once the report was complete, officers had an opportunity to view their BWC footage and were told they could revise their report as appropriate. Details in each report were counted and compared to a 'gold standard', which was defined as the details known to be true about the scenario from developing it and from observing footage of it from an independent moderator's video. Dawes and his colleagues quantified the number of errors between initial reports, pre-BWC observation, and revised reports, post-BWC observation. They also categorized these errors according to their operational relevancy as 'minor', 'moderate', or 'major' errors.

Findings from Dawes et al.'s (2015) study revealed that, following observation of BWC footage, reports became more accurate. Reviewing footage from the BWCs allowed officers to correct, on average, 2.63 minor errors, 5.4 moderate errors, and 0.9 major errors, including 21 errors related to miscounting, mis-sequencing, or omitting force, warnings, or compliance descriptors. Assuming that any revisions made to the reports were because the BWC footage truly elicited that memory from an officer's memory store, rather than providing 'new' information that had not been encoded by the officer, the results are consistent with research examining other wearable technologies (Hodges et al. 2011; Loveday and Conway 2011; Silva et al., 2018); that is, observation of the BWC footage enhanced officers' memory of the event. Dawes and his colleagues contend that many of the errors that were corrected via observation of the BWC footage could have led to "…challenges of the officers' credibility, successful pursuit of an excessive force complaint, or dismissal of charges" (p. 15).

Interestingly, certain details in the BWC footage examined by Dawes et al. (2015) that should have cued proper recall were still inaccurate in the revised report. For instance, even after viewing the BWC footage, more than half of the sample failed to notice a third person in the room and instances of UoF occurred that were still not reported in revised reports. These types of errors would likely increase in naturalistic settings where the difficulties associated with memory retrieval would likely be more severe. Indeed, while Dawes et al. (2015) note that their sample consisted of rested officers, who were experiencing minimal stress and distractions, this is far from the reality faced by most officers in the field (Andersen and Gustafsberg 2016).

In summary, while BWCs cannot *replace* officer reports,[2] just as a camera cannot replace the human experience of an event, they may help mitigate some memory issues occurring during officer-involved UoF events or any other police-public encounter. Video footage might cue recall for certain aspects of an event, ensuring more complete and accurate accounts. Apart from the few studies reviewed above though, very little research has examined how BWCs impact memory processes, and more research is urgently needed to explore these issues.

[2] This is especially true given that BWCs can never explain why an officer made the decisions he/she made, or whether those decisions were reasonable in the circumstances. Only an officer, using their own words, can provide this information.

Potential Negative Consequences of Body Worn Cameras for Memory

While research suggests that BWCs may have real value for police services (Ariel et al. 2015; 2016b; Bureau of Justice Assistance 2016; Jennings et al. 2015, PERF 2014; White 2014; White et al. 2017), some researchers have raised concerns with the idea of them being omniscient. For example, The Force Science Institute has highlighted several operational limitations of BWCs, such as the fact that they are unable to capture depth and peripheral information (Force Science Institute 2014). While an officer might notice threats to the side of them, for instance, BWCs positioned on the officer's chest will probably not capture these threats. Even BWC models that attempt to increase the field of view by utilizing fish-eye lenses are limited by the distortion these lenses can cause. Danger cues that an officer observes could also easily be missed by a camera if the officer unintentionally obstructs the camera's view, by raising their gun in front of the camera for example (Boivin et al. 2017). Furthermore, very subtle tactile cues that may be felt by officers, like a subject's body tensing, and factored into their risk assessment, are unlikely to be captured by a BWC.

It has also been argued that BWCs may not provide sufficient context to allow police-public encounters to be fully understood (Dawes et al. 2015). Rarely, for instance, does BWC footage include the events leading up to an interaction since most cameras are not set to record continuously (e.g. due to privacy issues; Miller 2016). Moreover, BWCs are only able to capture interactions from one particular perspective or angle, and this can impact how viewers of the footage perceive the interaction; much like how camera angle impacts understanding in other contexts, such as videotaped interrogations (Lassiter et al. 2002). For example, Boivin et al. (2017) provided participants with two perspectives of the same incident, which involved an officer using lethal force on an assailant who was threatening police with a baseball bat. One perspective was from a BWC; another was from a surveillance camera placed in a corner of the room. The results indicated that participants who viewed the BWC footage perceived the assailant to be further away from the officer compared to individuals who viewed the surveillance footage. Those who watched the BWC footage also believed that the officer fired their weapon earlier than necessary.

Misinformation-Type Effects

The physical restrictions of BWCs cited above limit, to some extent, what they can tell officers (as well as the courts and the public) about what happened in any given instance. There are, however, also cognitive consequences to having officers view their footage before preparing a statement about an event. Viewing one's footage prior to preparing a statement may promote deceit for instance; an officer could, theoretically, lie about what they observed during an encounter based on what the footage revealed. An officer could claim, for example, that a gun observed at the scene, which was visible in the BWC footage but not originally encoded by the officer, was the basis for their lethal force decision. Moreover, allowing officers to view their footage before preparing their statement could also result in misinformation-type effects, whereby details from the video are *unintentionally* incorporated into an officer's 'memory' of the event, even if those details were not originally encoded (Loftus 2005).

In contrast to typical misinformation studies, where the post-event information that is presented to research participants is often factually incorrect information (Loftus et al. 1989), the information that may be incorporated into one's memory from BWC footage might not be 'incorrect', but simply not originally encoded by the responding officer. Grady et al. (2016) argue that while BWC footage provides true information, it may be different from what an officer actually noticed and could inadvertently bias their memory accordingly: "Even though their report may seem more accurate since it confirms to the objective reality of the situation, it is actually less accurate about the officer's perception of the event, which may be far more relevant when it comes to figuring out what led to the use of force" (p. 247).

The misinformation effect has been well-studied in laboratory settings, and the effect has been shown to exist for misinformation that ranges from minor details to very significant life events such as being lost as a child or the victim of an accident (Loftus 1993; Porter et al. 1999). Researchers who study these issues have also identified a range of factors that influence the likelihood of internalizing misinformation, and these factors are now reasonably understood (Loftus 2005). Much of this research leads us to believe that misinformation-type effects are distinctly possible in the police setting where BWCs are involved. Not only does it seem possible that officers could misremember important details of their encounters with the public, but the environment within which they will be encoding aspects of these encounters are particularly conducive to misremembering.

For example, Loftus (2005) suggests that misinformation is more likely to be internalized when memories for the event in question are weak. This may accurately characterize many police-public encounters, especially those that involve the use of force, because these encounters often unfold rapidly in less-than-ideal environmental conditions (e.g. low light). Such encounters are also frequently complex in nature and they generally induce stress. All of these things can negatively impact cognitive functioning and can result in weak memory traces of an event (Artwohl 2002; Klinger 2004; Sharps 2010). Under these circumstances, it might be quite easy for an officer to misattribute the source of some detail contained in BWC footage of an event; they

may genuinely think that the detail was observed while at the scene, when in fact they did not attend to the detail until they were exposed to it while watching the BWC footage. Indeed, even in situations that are far less stressful than police-public encounters, individuals frequently exhibit such source misattribution errors. In fact, misattributing the source of a memory is considered to be one of the 'seven sins of memory' given how frequently it can occur (Grady et al. 2016; Schacter and Dodson 2001).

The only study we are aware of that has examined the impact of BWC viewing on report writing is the previously discussed study by Dawes et al. (2015). As indicated above, Dawes and his colleagues found that viewing BWC footage influenced the information contained in post-event statements. Unfortunately, it is not clear from the results reported by Dawes et al. (2015) whether viewing BWC footage of an event led the participating officers in that study to present originally unobserved, yet important, information in their reports to justify their actions in the encounter. Future research is needed to examine this concern. By carefully tracking differences between the reports of officers who either view their footage prior to or after completing their statement, we might obtain a better understanding of this issue. We believe that mobile eye-tracking technology will also play a valuable role in such research. Data from eye-trackers may allow researchers to determine more precisely what an officer attended to during a simulated event. This should assist with the task of distinguishing between details including in post-viewing statements that were legitimately forgotten, but cued by BWC footage, and details that were not originally encoded, but visible within the BWC footage.

Retrieval-Induced Forgetting

Another memory-related concern associated with BWCs, especially in cases where officers are permitted to view their BWC footage before providing a statement about an incident, is that they may foster retrieval-induced forgetting (RIF). Retrieval-induced forgetting refers to the phenomena whereby the act of remembering part of an event prompts other aspects of the event to be forgotten (Grady et al. 2016). Retrieval-induced forgetting has been consistently demonstrated via the retrieval-practice paradigm (Anderson et al. 1994; Camp et al. 2012; Murayama et al. 2014). In the retrieval-practice paradigm, individuals learn a list of word pairs (e.g. fruits-banana, drinks-coffee), and practice retrieval on half of them (e.g. drinks-coffee). They then receive a test where they are asked to recall all word pairs. Not surprisingly, retrieval practice tends to improve recall of the practiced material (drinks-coffee). However, the retrieval practice also appears to "… [impair] recall of the unpracticed material (fruits-banana), relative to a control condition in which no retrieval practice occurs at all" (Johansson et al. 2006, p. 1335). Hundreds of studies have been conducted investigating the effect of RIF, with several literature reviews and meta-analyses finding that remembering certain things does in fact lead to memory loss for other things (Murayama et al. 2014; Storm and Levy 2012; Verde 2012).

Some scholars have theorized that RIF occurs as a result of an inhibitory mechanism (Anderson 2003; Levy and Anderson 2002; Storm and Levy 2012). According to this view, when an individual attempts to retrieve a certain item, multiple, related items are activated. This creates competition such that an individual must inhibit the related items in order to selectively retrieve the to-be-remembered item from their memory bank. Consequently, the inhibited items are less accessible. In other words, inhibition reduces interference from competing memories, resulting in enhanced recall of practiced items, but a loss of unpracticed items. Others have argued that RIF is better explained by strength-based competition or blocking (Jonker et al. 2013; Raaijmakers and Jakab 2013). Proponents of this view argue that retrieval strengthens certain items, consequently causing them to interfere with non-strengthened (i.e. unpracticed) items. The interference prevents the unpracticed items from being retrieved. Essentially, when one attempts to retrieve an unpracticed item, it is blocked by the practiced item. Murayama et al. (2014) conducted a meta-analysis to better understand whether RIF occurs as a result of an inhibitory mechanism or if it is better explained by a strength-based competition or blocking mechanism. They examined 512 samples utilizing 759 effect size estimates and found that the results supported an inhibition mechanism, although some evidence relevant to strength-based or blocking existed as well.

In either case, RIF may occur in contexts where BWC technology is used. When officers watch their BWC footage, they are essentially re-exposed to a to-be-remembered event. The act of watching one's BWC footage may thus be comparable to someone receiving additional retrieval practice on certain word pairs. However, as argued previously, BWCs do not necessarily capture details of an entire incident, including details that an officer may have attended to. An officer who sees their BWC footage before providing their statement about the event may be able to document what is in the footage, but could experience worsened recall for anything not captured by the BWC; that is, information outside the camera's view, their internal perceptions, or obstructed items (Grady et al. 2016). Future research that utilizes the retrieval-practice paradigm in a policing context may thus hold value. If, for instance, police who review their footage accurately report aspects of the incident captured in the recording, but fail to report other, not captured, non-reviewed portions of the event, then policy may need to be adopted related to when footage can be seen in relation to report writing.

Cognitive Offloading

Lastly, beyond these concerns related to the appropriate timing of when to view BWC footage, research suggests that BWCs may be associated with other, yet to be explored, negative consequences related to officer memory. Indeed, research from non-police settings suggests that the presence of a camera *itself* could change the way that officers encode information during their encounters with the public (Gilbert 2015; Henkel 2014; Marsh and Rajaram 2019; Risko and Dunn 2015; Risko and Gilbert 2016; Soares and Storm 2018; Sparrow et al. 2011). In fact, recent research is finding that, when possible, individuals may attempt to reserve limited cognitive resources by engaging in a process commonly referred to as cognitive offloading (Risko and Gilbert 2016).

According to Risko and Gilbert (2016), one may offload cognitive demands 'onto-the-body' or 'into-the-world'. When one physically moves their body to facilitate understanding and reduce demand, they are attempting to offload cognitions 'onto-the-body'; this is referred to as 'external normalization'. Risko and Gilbert give the example of tilting one's head to the side when trying to interpret a rotated object. The head tilt normalizes the object's orientation so that it is more consistent with a representation of that object that is stored in memory. Alternatively, offloading cognitions 'into-the-world' is called 'intention offloading'. This form of offloading is generally used to enhance prospective memory. The use of reminders, lists, and alarms are all ways one might reallocate mental tasks to technological prostheses in order to remember something later. Using a BWC to 'remember' an event is a form of intention offloading that BWC-equipped police officers might practice.

Research suggests that individuals are more apt to rely on intention offloading when it is difficult to recall to-be-remembered things; namely when there is a lot of information to retain, or if there are interruptions or other difficulties experienced during the encoding process (Gilbert 2015; Risko and Gilbert 2016). An individual who is experiencing stress or exposed to a complex situation in which there are multiple tasks required of them is thus likely to offload. This, of course, is the exact situation that police officer often find themselves in—potentially dangerous situations are frequently encountered, where multi-tasking is common and consequential decisions must typically be made, sometimes very quickly, on the basis of a risk assessment that takes into account a variety of interacting risk factors (e.g. subject behaviours, environmental variables, tactical considerations; Sharps 2010).

In many respects, using physical devices such as BWCs as an extension of memory is beneficial. As Risko and Gilbert (2016) argue, "Offloading cognition helps us to overcome… capacity limitations, minimize computational effort, and achieve cognitive feats that would not otherwise be possible" (p. 676). In other words, relying on a device like a BWC to store something that would have otherwise been the job of an officer's working memory (WM) system increases the chance that details are accurately retained, and frees up space for other cognitive (e.g. communication, problem-solving, or decision-making) and motor tasks (e.g. unholstering, aiming, or deploying a UoF intervention option). However, intention offloading, which has peaked with the advent of the internet, has also raised concerns among academics and the public (Risko and Gilbert 2016; Sparrow et al. 2011). Indeed, even the media has questioned whether technology is being abused (Carr 2008). It appears that the ease with which we can acquire, store, and retrieve information almost instantaneously from technology has resulted in the offloading of simple, easily remembered information (Gilbert 2015; Risko and Gilbert 2016).

A seminal study by Sparrow et al. (2011) investigated the cognitive consequences of having constant, easy access to information. Across four studies, Sparrow et al. (2011) found that (1) people are primed to think about computers when presented with a question, as opposed to searching their own memory for answers to the question at hand, even when the answer to the question is known; the effect is particularly acute though, when the question is hard; (2) people who believe that they will be able to access information later are less likely to encode that information, and thus appear to have more difficulty recalling it; (3) people have difficulty recalling where they accessed online information from; and (4) people are significantly better at recalling where information is kept (e.g. a particular website), than the actual saved information itself.

Although not confirmed yet in the police setting, such findings have clear implications for officers wearing BWCs who are involved in challenging interactions with the public, if such results are shown to generalize to this setting. Given research showing that stress can result in gaps in knowledge (Shields et al. 2017), Sparrow et al.'s (2011) findings suggest that officers may be particularly prone to offloading. Moreover, if officers believe they will be able to access information about an event later via their BWC footage, Sparrow et al.'s study suggests they will be less apt to encode information about the event, which is likely to hinder recall. This could prove especially problematic when BWC footage ends up being unavailable after the event, either because the camera was not recording due to human error or technological issues, the footage is of low quality, or the officer is not allowed to view the video.

Several other studies have also demonstrated a 'save-and-forget-it' type effect, whereby knowledge that information is being saved in another form impairs encoding of that information at the point of contact (Henkel 2014; Risko and Gilbert 2016; Soares and Storm 2018). For example, Henkel (2014) investigated memory for observed versus photographed objects in two experiments. In the first

experiment, she led ($N = 27$) participants on an art museum tour. Participants were directed to 30 different artefacts on the tour. They were told to only observe half of the objects, whereas they were told to photograph the other half. In all cases, they were asked to pay attention to the objects and were informed that they would later be asked about the objects. Following the tour, Henkel had participants recall the objects and object details. She tested the participants' memory of the objects with free recall, and then via an activity that asked them to name the objects, recognize them visually using a photograph, and report details about them using multiple choice questions. The results demonstrated a 'photo-taking impairment effect'—if participants had taken a photograph of the object, they were less likely to remember it and reported fewer details about it.

In her second experiment, Henkel (2014) hypothesized that the act of taking the photograph may have interrupted the amount of time that participants had spent examining, and therefore encoding, the object. It was further posited that narrowing in on the object may draw attention to the object in a way that photographing it in its entirety does not. As such, participants were given additional time to view the objects when they took photographs of them. In addition, for some of the objects, participants were asked to zoom in on a part of the object before taking the photograph. According to Henkel, "Despite the added time or attention required to angle the camera and adjust the lens so as to capture the best shot of the object in its entirety, the act of photographing the object appears to enable people to dismiss the object from memory, thereby relying on the external devise of the camera to 'remember' for them" (p. 401). Assuming that Henkel's participants were not experiencing any exceptional stress on the museum tour, it appears that the presence of a camera might alter recall even under innocuous, low-threat circumstances.

It is important to emphasize that, while the non-policing research cited above suggests that cognitive offloading may occur if officers encounter challenging situations and think that they will have access to BWC footage available to them, post-event, it may be that contextual factors in the police setting prevent this from occurring. For example, it is possible that the training police officers receive prevents offloading from occurring; this is obviously training that typical research participants who exhibit offloading do not receive. Additionally, an officer's awareness that they may have to articulate what occurred during an encounter, due to organizational policies or legal requirements, could prevent offloading from occurring; again, this is clearly something that would not concern the sort of individuals participating in the previously discussed studies. Thus, future research is needed to confirm whether being equipped with a BWC may negatively impact memory for encounters with the public through cognitive offloading. This could easily be done by conducting experiments with officers who are made to believe (or not) that they will have access to their BWC footage while they prepare their post-event report. If both groups of officers are not provided access to their BWC footage, and differences emerge in recall accuracy, cognitive offloading may be to blame.[3]

Conclusions

Body worn cameras are now being used by officers in many police services. However, it appears that the popularity of BWCs has outpaced research on this technology. Much of the research that does exist suggests that the use of BWCs is associated with valuable outcomes, such as decreased UoF on the part of police officers and fewer complaints made about the police by members of the public. To the extent that such results replicate and generalize to other settings, this is obviously good news. However, concerns have also been raised about this technology. Many of these concerns relate to technological and practical limitations associated with BWCs. There is clearly a need for people to be aware of these limitations and to take them into account when viewing BWC footage and deciding how much weight to put on these videos. In the current paper, we conducted a literature review that focused on another aspect of BWCs that has received less attention—how BWCs might impact memories for police-public encounters, especially those encounters that involve UoF.

Unfortunately, we could find few studies that have examined this issue within a police setting, so we were forced to look further afield to find research that speaks to this topic. Much of the research we located suggests that BWCs may have a positive impact on an officer's memory for previously experienced encounters. For example, a reasonable amount of research supports the view that visual imagery can be used to facilitate recall. Indeed, regardless of whether one examines a static photograph, a series of static images (e.g. SenseCam), or a dynamic video recording, it appears that these sources of information can be used to facilitate recall by cueing forgotten memories. This research raises the real possibility that BWCs will play a similar memory-enhancing role in the policing field, by providing a useful aid to police officers who must frequently have to recall details of encounters that may have been complex or stressful.

However, existing research also raises another, less appealing possibility; that in some cases at least, BWCs may have a negative effect on an officer's memory. Indeed, research conducted outside of a police setting highlights three specific

[3] We are currently in the process of completing such a study. One group of officers in our study were led to believe that they would have access to their BWC footage, post-event, which might encourage cognitive offloading. After the event, we feigned that their BWCs had malfunctioned and thus they had to prepare their statement without the aid of their BWC footage.

issues that we need to be concerned about—misinformation-type effects, RIF, and cognitive offloading. We have to be particularly concerned about these issues because the characteristics of many police-public encounters are consistent with the sorts of conditions that result in these effects. For example, cognitive offloading is more likely to be observed under conditions where the encoder is overloaded in some way (e.g. due to stress or scene complexity), which is likely a common occurrence for many police officers.

To be clear, there is, as of yet, no strong evidence to suggest that these negative effects are associated with BWCs. In fact, there are good reasons to think that they may not actually be a problem in the police setting. Indeed, unlike typical research participants, police officers receive training, and are governed by policies and laws, that may enhance their encoding abilities or, at the very least, encourage careful observation. However, given the consequences of the sorts of effects described above, we need to be concerned with the possibility that they might occur. In addition to studying the positive outcomes associated with BWCs, researchers should turn some of their attention to these other issues. By conducting such research, it will be possible to determine the degree to which these potential problems exist, under what conditions they emerge, and what might be done to minimize their impact.

Only once such research has been conducted can we fully understand how we might combat the potential negative effects associated with the use of BWCs. But, one can imagine what sorts of implications might arise from such research. Training may need to be revised to stress to officers the importance of memory encoding during police-public interactions. For example, officers cannot assume that BWC footage of the event will be available, post-event. There may also be policy recommendations that emerge from such research, such as where BWCs should be placed on the officer to maximize video quality or when BWC footage should be viewed in relation to note-taking and providing a statement. Undoubtedly, there will be things that even BWC manufacturers can learn from such studies as well, such as features of cameras that could be particularly beneficial if cognitive offloading appears to be a problematic issue.

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