Chapter 9
Knowledge-Based Policing: Augmenting Reality with Respect for Privacy

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Abstract. Contemporary information-led policing (ILP) and its derivative, knowledge-based policing (KBP) fail to deliver value at the edge of action. In this chapter we will argue that by designing augmented realities, information may become as intertwined with action as it can ever get. To this end, however, the positivist epistemological foundation of the synthesized world (and ILP and KBP for that matter) has to be brought into line with the interpretive-constructivist epistemological perspective of every day policing. Using a real-world example of the Dutch National Police Services Agency (KLPD) we illustrate how augmented reality may be used to identify and intercept criminals red-handedly. Subsequently we discuss how we think that the required data processing can be brought into line with the legislative requirements of subsidiarity, proportionality, and the linkage between ends and means, followed by a discussion about the consequences for, among other things, privacy, discrimination, and legislation.

9.1 Introduction

The increasing digitization of services and goods, in combination with the expanding possibilities to interlink and provide them through networks such as the Internet, affects modern-day society in unprecedented ways (Castells 2000). From a policing perspective these developments result in new challenges to be met. For example, compared to criminals the police is slow in adapting to this new digital (or synthetic, or virtual) environment. An environment, which becomes more and more integrated with our real environment. At the same time, we observe that contemporary information-led policing (ILP), and knowledge-based policing (KBP) for that matter, is mostly restricted to strategic and tactical information, including overviews of hot crimes, hot times, hot spots, and hot shots. So far, ILP fails to deliver operational value in action. Designing augmented realities is one way to

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fill this void. Before we can discuss the application of augmented reality, however, we have to unify the underlying epistemological bases (philosophy concerning the nature of knowledge) underlying the ‘real environment’ and the ‘synthetic environment’ of policing. Within the policing profession the distinction between the two epistemological bases becomes clear by examining perspectives on ‘old' and ‘new’ knowledge. In policing ‘old’ knowledge refers to knowledge related to traditional case-specific criminal investigations; ‘New’ knowledge refers to knowledge gained through digital data analysis, including the identification of trends, hotspots, ‘hot moments’, and other patterns (Ratcliffe 2008). Exploiting the potential of ‘new’ knowledge has become known as ILP, which in the Netherlands developed into a doctrine (Kop and Klerks 2009). As information within the ILP doctrine is treated as ‘data given meaning and structure’ (Ratcliffe 2008a: 4), its epistemological basis is clearly positivistic. Indeed, information is treated as an object that may be stored, enriched, and disseminated. In traditional case-specific criminal investigations, on the other hand, police officers are utterly aware of context, antecedents, and idiosyncratic perspectives. Hence, ‘old’ knowledge clearly has an interpretive-constructivist epistemological basis.

The emerging concept of KBP, which is an offspring of ILP (Brodeur and Dupont 2006), is thought to bring the worlds of 'old knowledge' and 'new knowledge' together (Ratcliffe 2008; Williamson 2008). To do so successfully, however, we argue that the epistemological bases have to be unified first. The positivist basis of ILP does not provide for the divers, dynamic, and complex nature of information which characterizes 'old’ knowledge-based police work. Hence, we propose to follow Innes et al. (2005) and adopt an interpretive-constructivist perspective for both ‘old’ and ‘new’ forms of knowledge. We make this proposal specific by redefining the key-concepts (data, information, knowledge, and intelligence) accordingly. We then introduce the concept of boundary objects. This serves two purposes. First, boundary objects help to bridge the gap between information analysts, police officers, and other fields of discipline (Bechky 2003; Carlile 2003). Second, we use boundary objects as knowledge-structure to augment reality.

After our modest attempt to create a more suitable and holistic basis for KBP we turn our attention to augmented reality. Where people are limited to five highly sophisticated senses to observe their environment, virtuality provides opportunities to augment reality. Not necessarily by algorithms and routines that unearth hidden trends or other patterns in large databases, but in particular by processing data which is automatically obtained, filtered, and analyzed in real-time (through profiles) and integrated in policing practice, much like our human senses do. Where human senses, however, are intrinsically restricted to a given time and place, this is not necessarily so for artificial sensors. For example, a series of discrete observations of multiple geographically distributed sensors may be united into one composite observation. Such an endeavor requires the processing of large quantities of -often privacy related- data. Moreover, the observations include data related to people that legally may not be suspected of any legal offense. Hence, the application of augmented reality has to be brought in accord with the juridical framework of policing. We believe that KBP, as we are presenting it, provides a suitable basis for developing augmented realities that comply with the guiding juridical principles of proportionality, subsidiarity, and the linkage between ends and means.

In the following section we first provide a brief overview of ILP, followed by an epistemological reorientation of its key-concepts: data, information, knowledge, and intelligence (henceforth: key-concepts). In the section Knowledge-based policing we explain where current KBP theorizing falls short in uniting old and new forms of knowledge, followed by an explanation of what we see as needed to develop successful augmented realities. After creating the foundation for augmented reality we discuss what it takes to create augmenting realities and illustrate this using a case of the KLPD concerning the fight against drug-trafficking. This chapter ends with a discussion about, amongst things, privacy, discrimination, legal consequences, and a conclusion.

9.2 Intelligence-Led Policing

9.2.1 Origin and Epistemological Basis

ILP is a concept that originated in the 90s in England. A description of what Maguire called ‘intelligence-led crime control’ became the widely used definition of ILP (Lint 2006):

“a strategic, future-oriented and targeted approach to crime control, focusing upon the identification, analysis and 'management' of persisting and developing ‘problems’ or ‘risks’” (Maguire 2000:316).

ILP is formally incorporated in the National Intelligence Model (NIM) of England, the core business model for policing, which is being described as an information-based deployment system aimed at ‘identifying patterns of crime and enabling a more fundamental approach to problem solving in which resources can be tasked efficiently’ (Centrex 2005:10). The British NIM functions as role-model for the creation of a NIM in the Netherlands, where ILP took flight in the beginning of this century (Abrio 2005, Hert et al. 2005). As the NIM is being used by the government (both in England and in the Netherlands) to implement standard ILP-practices, its influence on policing is substantial.

The resulting ILP-practices, at least in the Netherlands, are highly focused on the creation of information products (mostly in textual and numerical form) to direct police action. They are either focused on individual cases (reports), or driven (and limited) by statistics based on recorded data, such as criminal trends, hot spots, hot-moments, and social network analysis. Although these figures and facts may be useful to prioritize work (e.g. to select hot-spots that deserve additional attention), and as such may help to reduce crime (cf. Makkai et al. 2004), the information products offer little insight in the structure of criminal phenomena, the functioning of criminal networks, or the distinguishing signals that indicate (red-handed) criminal activity.

Before we illustrate how policing practice can benefit from products such as augmented reality that prescribe contextual actions (complementing the existing products that confine themselves to descriptions of the outer world), one should notice that the epistemological basis of the NIM and ILP, and thus, these products, is highly positivistic. From a positivist perspective, data, information, knowledge, and intelligence are treated as objects that can be obtained, recorded, enriched, analyzed, and disseminated. Moreover, the positivist line of reasoning is that (digital) data is the start of a chain from data to information to knowledge to actionable knowledge (intelligence) (Carter 2004; Kop and Klerks 2009; Ratcliffe 2008a; Williamson 2008). This data-driven logic can easily be reversed to a knowledge-driven logic. Indeed, knowledge must exist before information needs can be articulated, after which data can be collected, structured, and analyzed (Tuomi 1999). Both forms of logic, however, treat data, information, knowledge, and intelligence as concrete classes of objects, which after forming are little affected by context, personal interpretations, the social negotiation of meaning, or time. In the resulting mechanistic view attention is lop-sided to processing explicated, decontextualized, and encoded data. In practice this comes at the cost of losing the social richness of 'soft' knowledge (implicit and tacit forms of knowledge) (Innes et al. 2005). This negatively affects what information should be about: inform action. As we consider a positivist perspective on data, information, knowledge, and intelligence a too limitative foundation for creating augmented realities, we propose to reorient these key-concepts from an interpretive-constructivist epistemological perspective.

9.2.2 Reorienting Data, Information, Knowledge, and Intelligence

In this section we make an attempt to describe the ILP key-concepts from an interpretive-constructivist perspective. The descriptions should be viewed as ideal-types in a Weberian sense. Hence, a real-world instance will often represent a combination of these ideal types.

Data

Based on ones interests one may decide to encode signals by using e.g. text, sound recordings, photographs, films, or models. Although these artifacts may serve different purposes (e.g. art), within the context of KBP they represent data. Thus, data are intentionally created and structured representations (or abstractions) of reality as we observe it. As perspective, methods and means used in the process of creating the data are related to an idiosyncratic purpose, the abstractions may or may not be useful for other purposes, or within other contexts. For example, a police register of Police Reports may be used to study criminal patterns (or generalizations). The design of the data collection, however, would have been quite different if it had had that purpose from the start. Moreover, it should be noted that data is dynamic as it may be deleted or become illegible, as keys, formats, or carriers get lost, obsolete, or damaged.

Information

Taking an interpretive-constructivist perspective (cf. Orlikowski 2002; Tsoukas 2000), information is viewed primarily from the perspective of informing. The process of informing may be intentional or unintentional, successful or not successful. For example, accidentally overhearing a conversation of your neighbors may inform you about an event (unintentional); a report designed to inform a management team about the state of affairs may inform some, but leave others in confusion (unsuccessful); observing your colleague may inform you about his mood today, but may as well leave you wondering (unintentional and unsuccessful), et cetera. In all cases the information process involves the transmission of signals (or data) from an information source (e.g. person, text, images, or sounds), and the registration and interpretation of these signals by a receiver (Shannon 1948). While these signals or data may be informational to some, they may be non-informational or even confusing to others, or interpreted in another fashion than intended by the sender. Reasons may include differences in idiosyncratic perspectives on reality, a lack of interest or attention, and the lack of knowledge or trained senses to notice the difference between the various signals or data. Moreover, the meaning, intent, or validity of data sent more then once might shift (Shannon 1948). Thus, information is highly idiosyncratic, context specific, and dynamic. It is based in differences that make a difference (Bateson 1979) for a given person or group in a given context at a given time. Moreover, it represents that selection of the data that modifies our state of knowing (Boisot and Li 2005) and informs action (Orlikowsi 2002).

Knowledge

Following an interpretive-constructivist perspective, knowledge is viewed from the perspective of knowing to emphasize the role of know-how (Dean et al. 2008; Orlikowski 2002; Tsoukas 2000) in addition to know-what and know-why in acquiring and using knowledge through practice and experience (Dean et al. 2008; Gottschalk et al. 2009). In this perspective knowing how and practice are mutually constitutive, thus dynamically co-evolve through time (Nissen 2006; Orlikowski 2002). For example, knowing how to recognize a criminal in action may include the identification of a number of indicators that may be used to augment reality. As many officers will confirm, however, as soon as criminals learn about these indicators, they will try to conceal them or change their modus operandi all together. As a result, the recognition of criminals in action is to be regarded as a highly dynamic and knowledge-intensive game of ‘cat and mouse’. As experience-records are idiosyncratic, so is the knowledge gained (and forgotten) in the process. It can only in part be encoded in generalized knowledge-rules. Moreover, some forms of knowledge (also called ecological knowledge (Walsh and Ungson 1991)) can only be remembered through direct interaction with the environment (one may recognize the case of a forgotten pin-code which may be remembered by visualizing the keyboard and remembering the pattern while typing it). Thus, knowledge is highly idiosyncratic, context specific, and dynamic.

Intelligence
Intelligence, defined by most police organizations as actionable knowledge, will typically proof to be actionable within a given context and time frame in the creative process of for instance the construction of a tactical plan to gather evidence or execute an arrest. As a consequence, intelligence can only be identified as intelligence in case-specific processes of planning, while it may lose its status of intelligence as the opportunity passes. Thus, like information and knowledge, what constitutes intelligence is idiosyncratic (related to a person or professional role), contextual, and dynamic.

9.3 Knowledge-Based Policing

9.3.1 The Need for a New Foundation

Like NIM and ILP literature, current KBP-literature has a highly positivist inclination, reflected in the positioning of knowledge as just another processing level in the data-information-knowledge-intelligence chain (cf. Williamson 2008). The consequence is that 'old' knowledge (of case-specific criminal investigations) became detached from 'new' knowledge (digital forms of pattern analysis). The division of work effectuates this. Where police investigation officers are dealing with 'old' knowledge, (sworn) desk officers deal with 'new knowledge' (Ratcliffe 2008). This division is not only effectuated in role, but also in organizational structure (Gottschalk 2008; Kop and Klerks 2009). The Dutch police consists of a large 'operating core' of police officers and criminal investigators that are organized in a hierarchical and geographical manner (neighborhood, district, region, (inter-) national). Following the NIM-structure (Centrex 2005) each level has a selection of facilities dealing with information and intelligence, based on the economical principles of specialization. Although this division may be justifiable from a specialization perspective, it comes at the cost of integration (Galbraith 1973). We hypothesize that the dominant positivist epistemological stance hinders the alignment and integration of old and new knowledge, which may explain why many police officers regard ILP as inadequate (KLPD 2011).

The solution as we see it does not rest in collecting more data, defining better information products, or improving the chain from producer to consumer (also known as sequential collaboration (Puonti 2007)), as may be expected from an positivist perspective. Instead, we advocate to adopt an interpretive-constructivist perspective and start approaching knowing and practice as mutually constituent (Orlikowski 2002). This means that forms of cooperation among desk-officers and executive police officers need to be stimulated to start the process of mutual informing, learning, and acting, i.e., to learn to work as a team (also known as parallel collaboration (Puonti 2007)). Key in this process is the identification and utilization of boundary objects, which we will discuss next.

9.3.2 The Role of Boundary Objects in Augmented Reality

Sharing the same epistemological basis is not sufficient for successful collaboration across different fields of discipline, such as information officers organized in information-units, executive police officers organized in squads, and technicians configuring augmented realities. To increase understanding across different fields of discipline people deploy boundary objects (Bechky 2003; Carlile 2002; Star and Griesemer 1989). A boundary object is an artifact that has meaning across practices and as such has the potential to improve coordination and synthesis across heterogeneous disciplines. Building on Star (1989), Carlile (2002) distinguishes three types of boundary objects, i.e. repositories; standardized forms and methods; and objects, models, and maps. Although all three play a role in augmenting reality, for the purpose of this chapter we elaborate on the last category, and more specifically, on models. This category of boundary objects is fundamental in structuring augmented realities.

We define a model as a generalized abstraction of a real world phenomenon, such as burglary, cargo theft, or drug trafficking. A phenomenon can be described in terms of e.g. 'business' processes and supply chains, social networks, favorite locations, and modus operandi. Such knowledge is typically distributed across different fields of discipline. Building a shared model aids participants to contribute what they know about the phenomenon through experience, observations, experiments, or desk studies. The model can then be used to (jointly) devise tactics, methods and means to approach the phenomenon and to find ways in which reality may be augmented. One such means is the application of profiles. Following Marx and Reichman (1984:4) we define profiling as a method 'to correlate a number of distinct data items in order to assess how close a person or event comes to a predetermined characterization or model of infraction'. Thus, each model may be translated into a number of (contextualized) profiles. If these profiles are used to augment reality, they have the potential to selectively make police officers 'in the field' aware of ongoing criminal activity and direct their attention accordingly.

To prevent boundary objects from becoming static and detached from practice, both models and profiles need to be subject of constant debate, stimulating the exchange of lessons learned, the creation of new intervention strategies and tactics, and the formulation of actionable hypotheses that can be tested in policing practice.

9.3.3 Realizing the Augmented Reality Potential

For the purpose of this chapter we define reality as the real world as one conceives it through ones natural senses, while virtuality (or artificial reality (Kruger 1991)) represents a fully (re)constructed, or synthesized world. Following Migram et al. (1994:283) we define augmented reality as 'augmenting natural feedback to the operator with simulated cues'. This is achieved by techniques that overlay reality with a stream of computer-synthesized data (virtual reality) (Fritzmaurice 1993). Although many characterizations (or indicators) of criminal phenomena can only be uncovered through interaction, some indicators may be detectable by means of technological sensors. These are potential candidates for augmenting reality. Examples include sensors for measuring weight, heat, speed, direction or route, or sensors which can be used to recognize texts on license plates, voices or faces. As policing takes place in public space, sensors used to augment reality need to be either integrated in the personal gear or equipment of police officers, or made available through a web of geographically distributed and interconnected sensors. In an ideal situation these sensors are seamlessly integrated in our natural environment, thus becoming transparent to natural persons (also known as ubiquitous computing (Weiser 1993)).

To facilitate the contextual presentation and interpretation of the real-time data-streams being produced by this sensor-network, knowledge-based systems are used (based on models) that can be customized to personal roles and contexts (using profiles) (cf. Feiner et al. 1993). The latter is of utmost importance to manage the volume of data being processed. For effectively augmenting reality, only those data have to be processed that are related to a particular officer who is working at a given location, at a given time, in a given context. Rather than storing all 'observations' of all sensors in perennial databases for offline analysis, for augmented reality only a selection of the ephemeral data-streams have to be analyzed in real-time. Based on explicated profiles these data-streams are used to assess how close a person or event comes to a predetermined characterization or model of infraction (Marx and Reichman 1984:4), thus rigorously endorsing the principle of 'select before you collect' (Jacobs 2005). Fitting a profile oftentimes does not provide sufficient legal grounds for treating someone as a criminal suspect. Like natural observations, however, synthesized observations just aid officers 'to select cases worth inspection' (Holgersson and Gottschalk 2008).

Augmenting reality in such real-time real-life environment is complex. This complexity is caused by several factors, including technical, financial, organizational, cultural, and not in the least of juridical and ethical factors. To name a few, networks of distributed sensors have to be integrated in the (fortified) ICT-network of the police, while the location and configuration of the sensors need to be attuned to the (fluid) criminal phenomenon under study; Police officers have to learn how to mentally integrate the augmented part of reality with their own observations and common sense, while the organization has to learn how to contextualize signals from their sensor-network and organize a response. Last but not least, the application of profiles has to be incorporated in the legal framework of policing. This includes the organization of mandates to act upon synthetic observations, defining the legal status of the data being processed, and the justification for breaching privacy due to the processing of person-related data. These particularities and the potential value of augmented reality in policing practice are illustrated in the grey box below.

Large numbers of drug-seeking tourists have been causing major problems in the public domain in the Dutch city of Maastricht for years. Traveling up and down the nearby borders of Germany and Belgium they flooded the city, visiting Dutch coffee shops, looking for drugs. These large numbers of customers attract criminal groups like drugs-traffickers and hard-drug retailers. As coffee shops, selling small amounts of soft drugs, are legal under Dutch law, local police have limited means to stop this criminal expansion. Retailing grams of cannabis and other drugs to thousands of tourists, however, requires a supply-chain of larger quantities.

As the problem had a clear community-transcending character, meetings were organized between local and national police officers to share knowledge about the phenomenon and discuss intervention strategies. Participants included criminal investigators, neighborhood police officers, highway patrol officers, and information and intelligence specialists. Through these meetings it became clear that Rotterdam was an important distribution center for heroine and other drugs. Moreover, it appeared that certain groups had specialized in import or retail, while trafficking the drugs from hidden stashes to retailers was the domain of other groups. While the import of larger quantities of drugs is very irregular and well hidden, and because the ultimate retail of small amounts of soft drugs is legal under Dutch law, it was reasoned that if the police would be able to discriminate between normal traffic and drug trafficking the criminal chain could potentially be most vulnerable during transport. Given the limited stock and high turnover of coffee shops, trafficking would be routine. Moreover, if the network of drug-traffickers could be made visible, it could provide clues about the location of drug-stashes, middlemen, and routes.

Follow-up sessions resulted in the construction of a ‘drug-trafficker model’ and profiles consisting of lists of indicators that officers could apply in specific contexts. Aided with these profiles several control actions on highways were organized, stopping and checking hundreds of vehicles. The results were very poor. Just grams of heroine were found. Clearly, human senses were not well suited to discriminate drug-trafficking behavior in large traffic flows, while most indicators were only assessable after a vehicle was stopped. As a consequence, the next question was how the spatial behavior of drug-traffickers could be discriminated from other vehicles ‘in the flow’ (with a density of circa 4000 per hour). What data was to be assessed and analyzed and how could this contribute to the ability of police officers to discriminate red-handed drug-traffickers from other travellers?

The solution was found in using a real-time complex event processing system, fed by live data-streams of automatically read license plates, assessed at four strategically chosen points along the route. One of the constructed profiles was aimed at detecting vehicles that travelled to and from Rotterdam and Maastricht within short periods of time, a pattern that investigation officers knew to be typical for drug-traffickers. The profile was further strengthened by combining this information with a list of license plates of vehicles that frequented coffee shops in Maastricht. This list could also have been generated automatically, if sufficient sensors would have been available. For the above profile data needed to be kept in memory for a short period only (number of hours). To reduce the impact of privacy invasion, reads of license plates that within this period did not score on the profile were automatically removed. Moreover, as the profile was based on time-spatial behavior only, the profile was discrimination-free.

At the beginning of the operation more seasoned policemen were sceptical about the idea that technology could complement their sentience. Initially, thousands of cars passed our sensors, with no results. After about an hour the first alert was generated. It appeared to be an ambulance of the Maastricht University Hospital, which had just delivered a patient at the Rotterdam Hospital. The driver was not amused, nor was the motor-policeman who carried out the selection, while "knowing perfectly well that this is not what he was looking for". At the end of that day however, out of as few as ten vehicles that were stopped as many as six proved to be serious drugs-traffickers. Caught red-handed, each carrying over a kilogram of soft and hard-drugs. These results convinced even our most sceptical colleagues. As one of them stated, "It is almost like Christmas day, the presents are delivered and we only have to unwrap them".

One week later, at a similar occasion, a taxi was selected based on information generated by the profile. Under normal circumstances taxis are never stopped. This time, too, the intuitive response was to let it pass. But it met all criteria of the profile. Additional information from a cop with local knowledge indicated that despite second thoughts the taxi could be worth inspection. It resulted in a find of over 1.7 kilograms of hard-drugs.

After using this profile for a sustained period, results started to decline. The drug-traffickers started to deviate from their usual routes, thus avoiding the temporal sensor-network of the police. The most logical route, however, had been compromised, forcing them to take deviant (and a bit awkward) routes. If the police would be able to deploy sensors on these routes as well, their detection would be easy.

The operations did fuel a healthy public debate about the application of sensor-technology by the police, the mandate of the police to stop a vehicle based on automated knowledge-rules, and the violation of privacy regulations due to the processing and alleged storage of large quantities of privacy-related data. Although the profile-based approach was approved in court, it was concluded that current law did not provide sufficient clarity for using augmented reality applications in police operations.

9.4 Discussion

Policing science distinguishes various knowledge- and intelligence-disciplines that are specialized in dealing with various abstraction levels, focal areas, and analysis techniques (Gottschalk 2008; Holgersson and Gottschalk 2008; Innes et al. 2005; Ratcliffe 2008). Discussing KBP, profiling, and augmented reality in relation to these disciplines is beyond the point and scope of this chapter. Instead, we limit the discussion to the implications of our contribution to the emerging concept of KBP with respect to the handling of large data-collections in relation to the real-time discrimination of criminal phenomena, including the impact on privacy.

9.4.1 Databesity: The Ever Present Hunger for Larger Databases

The positivist epistemological foundation of ILP and KBP falls short in acknowledging and dealing with the idiosyncratic, contextual, and dynamic nature of their key-concepts: data, information, knowledge, and intelligence. The positivist epistemological perspective is reflected in statements such as: 'information is data given meaning and structure' (Ratcliffe 2008a: 4). Although such definitions are straightforward and deeply ingrained in policing practice, in day-to-day business we observe that they tend to lead to discussions about format rather than informing, to unilateral processes of requesting and receiving information products (rather than dialogue), and to data-driven rather than knowledge-driven explorations. This data-driven focus often leads to something we call 'databesity', which we define as an urge to collect data for the sake of assembling (large) data collections in which –potentially– informative patterns may be found (cf. Innes et al. 2005). Finding and not finding these patterns urges to extend the data collection even more, either in depth or in breadth. Where the hunger of people with obesity, however, cannot be satisfied by eating (as the true cause is of another nature), so the data-hunger of organizations with databesity cannot be cured by collecting more data. Instead, KBP from an interpretive-constructivist perspective urges 'old' knowledge-type of questions to be raised when dealing with 'new' knowledge, such as: what is the problem to be solved? How can the criminal phenomenon be recognized? How are the criminals organized? What would be a good strategy to solve the problem? Who and what (including what data) are needed to execute the strategy? Approaching problems from this perspective leads to more focused data processing which is not limited to encoded data or computerized analysis techniques, but involves on-going sense making and natural world feedback based on behavioral and other cues. Indeed, to achieve augmented reality, ICT-affordances have to be integrated seamlessly into the construed reality of natural persons (Feiner et al. 1993).

9.4.2 Augmented Reality: Real-Time Processing of Data-Streams

Augmenting reality is a way for police organizations to bring ILP as close to practice as it can possibly get. To this end, however, focus has to be shifted from (persistent) databases to ephemeral data streams. The aim of creating and assessing data-streams is not to collect evidence, but to augment reality with a data-layer that complements the sentience and awareness of police officers, support sense making and decision making processes, and thus, inform action. Modelling augmented reality (i.e. configuring sensor-networks and data-layers) for such purpose is a continuous effort, taking into account the characteristics of the police officers, the phenomenon involved, its context, and its development through time.

Like shown in the grey box the creation of an augmented reality for fighting drug-trafficking was achieved by explicating and sharing knowledge of police workers, jointly developing hypotheses about the modus operandi of drug-traffickers, instructing officers to look out for related (mostly behavioral) signs, creating access to appropriate data-streams to identify generalized time-spatial behavior, and construct automated profiles to analyzing these live data-streams in order to create real-time feed-back for the police officers conducting the control. Little to none of this knowledge can be traced back to an existing database. But even if such data-collection would have been present, its predictive value would have been short-lived, as caught criminals learn fast. Short after the police successfully started to act on the hypothesized pattern, criminals adapted their modus operandi, creating new patterns that were slow to appear through the analysis of Police Report collections, if at all. Instead, criminal investigations, interrogation of caught drug-traffickers, qualitative analysis of Police Reports (rather than statistical), and common sense (read: experience) led to new understandings of criminal modus operandi. The result of the augmented reality experiment was that six from the ten selected vehicles deemed 'worth inspection' contained more then 1kg drugs – an unprecedented success for the Dutch police.

This being said, we do not claim that quantitative analysis of large data-collections is ineffective or of minor importance. To the contrary. We assert, however, that it is far from sufficient. At most it is complementary. For example, in the drug-trafficking case combining data sources and conducting social network analyses shed light on parts of the organizational structure that would have been overlooked otherwise (e.g. shared phone numbers, addresses, bank accounts). This effort contributed to the success of the operations because the analysts collaborated with the investigations team in a parallel fashion (Puonti 2007).

9.4.3 Developing an Ubiquitous Sensor-Network

As we have illustrated, augmented reality may already function with as few as 3 to 4 networked sensors. This augmented reality, however, can be extended substantially if more sensors can be used. This is not a matter of buying and deploying more sensors per se, as many (if not most) locations are already equipped with suitable sensors. Most of these sensors are government-owned, but few are interconnected. As a consequence one may observe that many locations are equipped with multiple systems, one for each governmental authority. We expect it to be a matter of time and economical sense before these sensors become interconnected.

Rather than fighting the rear-guard, we suggest to start thinking about formulating access and use regulations. As food for thought we suggest one initial measure. In contrast with current practice, in our view it would make sense to distinguish between the sensor, the data it produces, and the governmental authorities that are allowed to use the data (preferably in a real-time fashion, as we did). Where the format of the data and the physical location are determined by the sensor, the data-stream may be managed in terms of activation period and retention-time, while the use of the data by governmental authorities is determined by their legal mandate.

The governing principles of proportionality, subsidiarity, and linkage between ends and means (hereafter: the ruling juridical principles), rule out unrestricted access to and use of the network. Indeed, the ruling juridical principles signify that the means (i.e. mandates, resources, action) deployed by the police have to be proportional in relation to the offense, that there are no other means available with less impact, and that the means are deployed to reach a specified goal (e.g. restore order, catch the criminal). These ruling juridical principles imply that the use of means is always context-specific, never generic. Thus, when deploying a sensor-network to augment reality to combat (a specific form of) crime, all sensors that are activated through profiles need to contribute to this end. This is also in accord with the principle of 'select before you collect' (Jacobs 2005). Moreover, where citizens' related data is being assessed, the impact of large-scale privacy invasion has to be weighted against the ruling juridical principles, which is ultimately judged upon in court. Continuously collecting all data of all available sensors is obviously out of proportion.

9.4.4 Dealing with Privacy Invasion

In addition to the ruling juridical principles, all-inclusive access to the sensor-network is undesirable as it may lead to 'a feeling of omnipresent control' (Bentham 1843). Such feeling causes people to adjust their behavior, also known as 'chilling effect'. This effect is at odds with the right to be let alone, by some equated with privacy (Skousen 2002).

The invasion of privacy is absolute: it is invaded or it is not. Whether it is legal is case specific, involving the juridical principles of proportionality, subsidiarity, and the linkage between ends and means. Notwithstanding this harsh formulation it is possible to minimize the impact of privacy invasion. Within the context of augmented reality we distinguish three factors that together determine the impact of privacy invasion. The impact is influenced by the amount, detail and person-relatedness of the data being collected (we call this intrusion); the number of parties that may have access to this data (we call this spread); and the period that the data is being kept (we call this persistence). In the Dutch Data Protection Act, spread and persistence would be categorized under protection measures, which are aimed at minimizing the chance of unauthorized access and use of the data.

One of the reasons we propose to use ephemeral data-streams rather than persistent databases is that it allows for minimizing the impact of privacy invasion by minimizing spread and persistence, thus contributing to proportionality. Minimizing persistence contributes to 'the right to be forgotten' (Reding 2011), as well as to the prevention of 'function creep'. The latter is a concept of privacy scholars to denote that data obtained for one function tends to be used for other functions as well. By focusing on ephemeral data-streams, potential function-creep is limited to forward creep only (as data is removed from memory after real-time analysis). Moreover, with respect to spread, 'data controllers' (i.e. the police) 'must prove that they need the data rather than individuals having to prove that controlling their data is not necessary' (Reding 2011). In the Netherlands such proof is being approved by the Public Prosecution Officer and, in case of a trial, judged upon in court. Moreover, an important effect of this approval process is the self-correcting inclination to work with high integrity data and hypotheses.

As augmented reality, based on an interpretive-constructivist perspective, minimizes on intrusion, persistence and spread, with respect for privacy we present our version of KBP as a minimalist approach. Intrusion is being limited by the application of profiles, which means that the needed data is carefully selected before it is collected. Spread is being limited as the data is being tied to (immediate and localized) action. And persistence is being limited to the time required to complete the observation.

9.4.5 Dealing with Discrimination

Discrimination has a strong association with generalizations related to identity-related characteristics, such as race, ethnicity, religion, gender, social class, political affiliation, and so on, upon which action is illegal. Discrimination, however, can also be approached from a less-loaded mathematical angle, i.e. being able to differentiate.

Because in our case the synthesized part of augmented reality produces the leads to direct police attention, the impact of personal bias has to be eliminated during model and profile construction. Discriminating tendencies that are nonetheless encoded in the algorithms can further be neutralized by using corrective techniques to create discrimination-free classifiers (chapter 14). Most contributing to discrimination-free selection, however, is the fact that profiles are geared to detecting (time-spatial) behavior, rather than personal or social-economical characteristics (Alpert et al. 2005). Our rational is that being a drug-trafficker is not an offense: only the act of drug trafficking is. In the endeavor of identifying criminals red-handedly, reference to a single hotspot, hot moment, or hotshot observation may be used to strengthen a profile. The profile grows stronger, however, both in terms of effectiveness and in reduced bias, if multiple observations are used to determine behavioral pattern. Notwithstanding these efforts, behavioral profiling cannot completely prevent discrimination. For example, drug-trafficking related behavior, such as cruising a particular route, may also be characteristic to other (non-criminal) groups (Warren et al. 2006). In such cases profiles may produce too many false positives. This renders the profile less economical and, thus, mounts pressure to adjust the profile (which is true, of course, for all profiles).

9.4.6 Dealing with Group-Think

Group-think is a single-minded self-confirming pattern of thinking, not receptive for conflicting signals of the outside world (Cannon-Bowers et al. 1993; Janis 1972). The risk of group-think when working with augmented realities increases when feedback on profiles is not organized and subsequently used to update the profiles, or when a few dominant participants in model construction leave little room for others to discuss alternative explanations. Group-think shields police officers from identifying criminal behavior that does not fit their pattern of thinking. It reduces their creativity, their adaptivity, and, thus, their effectiveness. Measures to avoid group-think include diversifying the team (also in time), prevent dominant leadership, and building in randomness in the selection process (Cannon-Bowers et al. 1993). Moreover, police officers involved in creating layers of augmented reality as well as police officers making use of it during their operations need to nurture a critical attitude towards illegal discriminating bias that may have crept into their augmented reality. Just like they do in their not-augmented reality. As described by Thatcher (2005), failing to do so is bound to lead to 'trust-decay' in police operations.

9.4.7 Sustaining Trust

The way the police handles the above issues of data-collections, the sensor-network, privacy, discrimination, and group-think, all add up to trust: trust of police officers working within an augmented reality; and trust of citizen in police operations.

To start with the first, where in their daily practices police officers are utterly aware of the subtleties of language, context, and antecedents, this sensitivity seems to be absent when dealing with digital data (Innes et al. 2005). Artifacts, however, often lack context and history, unless such awareness functions are explicitly incorporated in its code. Ultimately an artifact acts as a 'finite state machine' (Arbib 1969): it does what it is programmed to do. If virtual reality is to be integrated into the reality of policing practices, these limitations of artifacts have to be engraved in the psyche of police officers whose reality is being augmented. During decision making each virtual representation of reality has to be validated and valuated against the context of that moment. Not complying with this baseline may severely impact the safety and security of police officers and the public, as decision making and action may be compromised by 'objective' yet erroneous signals. Thus, as (non-critical) artifacts are situated in practice, their agency has to be controlled by officers that are aware of the abilities and limitations of the artifacts used.

In democratic nations, citizens' trust in police operations is of utmost importance for the legitimacy of police organizations (Tyler and Wakslak 2004). At the moment most civilians (in the Netherlands) seem to experience the control measures of the government as soothing rather than undermining their sense of privacy (Boutellier 2007). This trust, however, has to be earned on a daily basis. By discussing the above issues we have tried to demonstrate that the development of augmented reality in police operations is a delicate enterprise. In our opinion, in contemporary society, in which the physical and the virtual world are becoming more and more interwoven, the question is not if the police should engage in augmented reality, but how it can do so in a responsible manner. To ensure that the benefits (catching more criminals through less control actions) outweigh the risks (culminating in public trust decay), this on-going development should be embedded in public debate. Moreover, efforts should be undertaken to formally regulate and supervise its use, obvious candidates being the Public Prosecutor and the Dutch Data Protection Authority (Cbp). To this end we discuss some legal issues related to acting within an augmented reality, followed by two considerations for future legislation.

9.4.8 Consequences for Legislation

Using augmented reality within the context of actions along roads is legally complicated. We will explain this based on the case described (see grey box).

In the Netherlands, the inspection of vehicles on roads is organized in the Road Traffic Law (Wegenverkeerswet). Possession of drugs, on the other hand, is organized in the Law on Opium (Opiumwet). If someone is suspected of carrying drugs, (s)he may be stopped for a check based on the Law on Opium. If there is no such suspicion, however, an officer is not allowed to evoke the Road Traffic Law for the sole purpose of conducting a drug-control. Such action would lead to *détournement de pouvoir* (misuse of powers), which often results in related evidence being excluded from the lawsuit. Thus, the augmented reality-adagio of 'aiding officers to select vehicles worth inspection' does not always hold. It only does if there are sufficient legal grounds for suspicion. If an officers observes a number of signs that (s)he relates to drug-trafficking, the officer has the right to approach that person as a formal suspect and use the mandates that follow from that suspicion. The question is whether clues detected by artificial sensors can lead to the same mandates. Of course, the value of a profile is as good as the intelligence used to make it. The drug-trafficking case, in which 6 of the 10 vehicles selected for inspection resulted in the detection of major drug offenses, proves that human intelligence of some experienced officers can successfully be used to augment the reality of many fellow officers.

At the moment of writing, the Ministry of Security and Justice (Ministerie van Veiligheid en Justitie) is drafting a law in which police officers are mandated to register license plate information using technology. To further the public debate on the incorporation of technology in policing we forward two thoughts for consideration. First, although in the drug trafficking case license plates have been used to recognize criminal behavior it should be considered to draft the law in more abstract terms. This would expand the range from the public road to other public domains such as railways, waterways, or cyberspace, Characteristics other than license plates (e.g. RFID) could be more but also less privacy intrusive, providing the police with alternatives to bring their approach in line with the juridical principles of subsidiarity, proportionality, and the linkage between ends and means. And second, neither current laws nor the law-in-preparation do provide for the forming of legal grounds for suspicion based on 'technological' assessments. The question is, of course, how purely technical these observations are. Indeed, in an augmented reality, based on an interpretive-constructivist epistemology, the division between the physical and the virtual world is diminishing. As a consequence, the question should not be whether an observation is physical or synthetic, but up to what degree the observation can be verified and trusted.

9.5 Conclusion

Like Ratcliffe, we believe that KBP 'requires police leaders to learn and embrace a new way of thinking about knowledge' (2007:2). In this chapter we made this plea specific by proposing to adopt an interpretive-constructivist epistemological perspective, reformulating the key-concepts of ILP and KBP accordingly, and forward boundary objects as means to 1) help bridging the gap between different fields of discipline, and 2) serve as knowledge structure for the creation of augmented realities. Moreover, what counts for police leaders is just as true for society at large: augmenting reality in police operations has consequences that should be considered with care. In this chapter we provided the first sketches of the consequences of augmented reality for large-scale data-processing, the protection of privacy, group-think, discrimination, and trust. It is our belief that the principles forwarded in this chapter represent a minimalist approach with respect for privacy.

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Abbreviations

ANPR	Automatic Number Plate Recognition
CBP	College Bescherming Persoonsgegevens
ILP	Information-led policing
KBP	Knowledge-based policing
KLPD	Dutch National Policing Services Agency
NIM	National Intelligence Model
OCR	Optical Character Recognition
RFID	Radio Frequency Identifier

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