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The Role of Big Data in Ambient Assisted Living

Abstract:

Big Data and biopolitics are two major issues currently attracting attention in public health discourse, but also in sociology of knowledge, STS Studies as well as in philosophy of science and bioethics. The paper considers big data to be a new form and instrument of biopolitics (Foucault) which addresses both the categories of *body* and *space*. It is expected to fundamentally transform health care systems, domestic environments and practices of self-observation and reflection. Accordingly the paper points out some problems and pitfalls as well as open questions that have emerged in the field of AAL, which merit more attention in future public and academic debate.

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Introduction

Big Data and *Biopolitics* are two major issues currently attracting attention in public health discourse, but also in sociology of knowledge, STS Studies as well as in philosophy of science and bioethics. The following paper considers Big Data to be a new form and instrument of *biopolitics* which is expected to fundamentally transform health care systems, domestic environments and practices of self-observation and reflection. The merging of Big Data and assisted living based information technological devices is intended to generate, store, interconnect, distribute and allow huge amounts and even highly diverse stocks of quantitative data to be used by health and social care providers, public services as well as users in private households. The visions of Big Data not only point to a multidisciplinary research area, a further step in rationalization, scientification and datafication of everyday life⁵⁸ – by gaining critical insights from data collected, shared and aggregated via fixed in-home sensor technology and mobile devices (Reeder et al. 2014) – they also represent a challenging shift in the “politics of life itself” (Rose 2007). What proponents of Ambient Assisted Living (AAL) arrangements⁵⁹ promise is to enhance personal security in residences as well as to raise and sustain the quality of life of disabled or sick people or aging individuals. It also caters to specific population collectives as, for example, in the case of obesity, borderline personality disorder or Alzheimer’s disease.

Big Data, smart homes and AAL are currently being hyped as a new technological and organizational revolution, a rapidly expanding market, and a promising business model which is expected to benefit from integrating data from AAL, remote monitoring by advanced electronic devices and related electronic patient and health records. Benefits of assisted living projects based on Big Data are projected not only for side of decision makers, managers and service providers, but also for consumers, promising reduced costs, real time analysis, early alert monitoring and thus more patient safety (Vimarlund/Wass 2014), although there is no empirical data and scientific evidence to justify these expectations so far. Currently, business and science policy have been pushing the concepts Big Data and AAL into the health and social care market (Groves et al. 2013). The available literature and studies on the topic focus mainly on the technological and socio-economic factors and related challenges (Vimarlund/Wass 2014). Going beyond a mere technological and economical view on this topic, how could one more appropriately frame this new and puzzling blend of data and technology (Groves et al. 2013)? A second glance reveals that the issue of Big Data and AAL is fundamentally related to the idea of leading a good life, i.e. the ‘best’ life possible. With regard to this, we assume that AAL projects are currently taking the shape of a new form of *biopolitics* that attempts to take on the task of both governance of individual and collective bodies (embodied persons as well as sub-populations) and surveillance of residential spaces (smart homes). What is peculiar to the case of AAL is that the idea of a good life, and thus the fundamentally ethical question of the appropriate conduct of life, becomes deeply entangled with smart technologies generating, gathering, mining, distributing, sharing and interpreting big amounts of (quantitative) data.

Although this announced technological revolution is still at an early stage, one can already discuss the question whether and with which consequences and (possible) side-effects it indicates a new qualitative step in biopolitics. According to the current public, health policy and academic discourse, the technological devices as well as patient records and health data are considered to support and facilitate everyday tasks of senior citizens or patient in households and adjacent areas by safeguarding their personal autonomy at the same time. We presume that looking at the concept of Big Data in AAL-context from a biopolitical point of view will open up a different perspective for examining the benefits and possible negative side-effects and pitfalls around AAL sites equipped with advanced electronic devices.

⁵⁸ See Weber (1981) and Weingart (1983) on rationalization and scientification, Driscoll (2012) and van Dijck (2014) on dataism, datafication and dataveillance.

⁵⁹ The term Ambient Assisted Living (AAL) was created for the European Joint Program in 2007; cf. <http://www.aal-europe.eu/>. Although it appears English in origin, the term has primarily been used in the German-speaking countries, promoted especially by the German Federal Ministry for Research and Education (BMBF). In 2011, the term was phased out of the ministry’s official documents and replaced by the term »Altersgerechte Assistenzsysteme« which could be translated by »age-appropriate systems of assistance«; cf. Manzeschke et al. 2015.

Big Data, sophisticated technology in residential areas and the ethos of a good life

What is behind the concept of Big Data?

The concept of Big Data is still a fuzzy one; this is basically due to the fact that what is 'big' is constantly shifting with technological innovation in the IT sectors. Big Data cannot be simply defined by datasets beyond a certain number of terabytes and the definition of what is estimated as big often varies by sectors or institutional fields. The amount of digital data doubles every two years. We know that currently every day some quintillions of data entries are generated by GPS locators, messages, computer-networks, pictures, wearables, etc. This data is supposed to become a great source of knowledge on the one hand, but at the same time the production, circulation, storage and use of this huge amounts of data is equally seen as a root of serious problems, which mainly relate to their reliability, transparency and to questions of data security as well as the protection of privacy (Zwitter/Hadfield 2014).

What are the prerequisites for the generation, interconnection, integration, storage and use of Big Data (Vilmarlund/Wass 2014)? (1) A first point to be mentioned is the need for a technological infrastructure. Devices for the collection of data can be located in the body, on the body, or they can be installed independently in residences. Among these smart technologies are wearable technologies, motion sensors, cameras, gateways, web-based applications (webcam, interactive computer systems). In this context it should be added that Big Data sets can either be static or real-time data, especially in the health sector there is an increasing demand for real-time data which allow for personalized diagnosis and treatment and to deliver health care tailored for specific populations.

(2) Big Data sets derive from different information streams, sources or data records. They can 1) be generated by humans (e-mail or notes by physicians), 2) they can derive from social media or the web, 3) they can be read from machine to machine (from wearables to clouds or platforms), 4) biometric data (fingerprint) and 5) from transaction data. A sophisticated technological infrastructure is thus needed not only for the collection of data but also getting access, mining, circulation and aggregating different and often unstructured digital data.

(3) Big Data becomes functional only when it is embedded in an effective organizational infrastructure or when a recognized structure is co-established with the creation of Big Data sets (e.g., in the case of health- and biobanks). One emerging field of research, development and application of a Big Data vision regarding electronic patient and health records, is represented by the concept of AAL (Knaup/Schöpe 2014).

Ambient Assisted Living

The idea of AAL is closely linked to the application of innovative state-of-the-art information & communication technology (ICT) products in private households or larger residences, be it wearable devices, sensors, computers, electronic goods and software as well as services (e.g., online information systems and platforms or services) (Wichert/Klausing 2015). The technological devices used in AAL sites in the first place focus on the collection of body related vital data. Sources of information can be embodied (e.g., chip cards, pace-makers), wearable technologies like smart watches, smart phones making use of health apps or smart glasses worn on the body or interactive computers systems (e.g., avatars), TV, and online information systems. Other devices are designed to monitor the residential space elderly citizens are living (Nitzsche et al. 2014).

What is now claimed to be new with Big Data in AAL is a change in the direction of information flow. Information does not longer flow from the public to the individual household; rather the flow is reversed or becomes multidirectional in order to take advantage of Big Data. In order to support senior patients at home and to deliver appropriate and in-time health and social services a sophisticated technological infrastructure is needed to monitor people at home including all physical activities as well as other daily routines and habits (e.g., nutrition, medication).

As with most of the key technologies hyped by science, industries and science policies the new blend of smart living and Big Data are more based on expectations than on evidence (TAB 2011). Thence, what are the "horizons of expectations" (Koselleck 1989)? One of the major arguments insinuates a coming efficiency revolution in health care, which is based on data records generated, distributed, stored by smart technologies, technical devices and services and retrieved and used by physicians, care services, insurances, etc. The central objective of Big Data is not collecting individual records but rather the aggregation and integration of data and data stocks from different technological and medical devices and sources, because it allows for a more comprehensive view on health (Knaup/Schöpe 2014: 150). The enhanced effectiveness proponents expect requires not only the integration of data from different sources, another prerequisite is also the interconnection of health care providers (nurses, physicians, care givers, health record banks, etc.) and the active patient or client as well. Concerning the latter, as Vilmarlund and Wass (2014: 146) stress, a motivation to accept and use the technological equipment is a necessary condition for the implementation of the AAL concept as well as a technological empowerment of the user is needed. What is often underscored by promoters of AAL projects is that the data as well as the data sources should be accessible and tailored for the health decisions related to the concerned individuals. Thence the question who has legal access to the Big Data and the conclusions drawn and the medical advices given on their knowledge base is another urgent question.

The ethos of a good life in AAL

What is the social and cultural background of this hype on Big Data based AAL projects? Of course we currently face a massive trend in the datafication of everyday life and a blossoming trend to dataveillance too, both fueled by an ideology of dataism (van Dijck 2014; Lupton 2014; Driscoll 2012). This, however, seems to be a latent prerequisite for expanding Big Data to the health service in AAL-settings. AAL promoters assert that modern developed societies are currently facing a fundamental demographic change. A constantly growing percentage of elderly or aging citizens corresponds with a lack of skilled employees in the medical and health sector (Demiris 2008; Demiris/Thompson 2011; Leone/Diraco/Siciliano 2011; Knaup/Schöpe 2014).

A second motive is the right for a self-determined life and societal participation of disabled or elderly people (cf. Convention on the Right of Persons with Disabilities, 2006). AAL concepts are supposed to enable citizens in increasingly individualized societies to live independently in their private apartments or houses and participate in society. Third, as far as the presumed severe demographic shift is believed to have severe consequences for the health sectors in contemporary societies, AAL is claimed to remove pressure from the health sector (Spitalewsky et al. 2013).

A fourth motive brought forward is the value of *health* itself. New smart technologies and Big Data are alleged to improve individual and public health substantially (Jacobsen et al. 2014), especially by constant telemonitoring of vital parameters (cf. Schmidt/Rienhoff 2013), be it in cases of patients or population segments with chronic diseases (hypertonic patient, chronic obstructive pulmonary diseases etc.) or patient with acute bodily disorders or those in periods of convalescence. Telemonitoring might, however, be used for preventive goals too (e.g., prevention of falls, heart-attack-patients) (Hilbe et al. 2010).

On the whole, we think, Big Data and AAL is not simple a promise for better health care and more safety. We believe even more that the idea of Big Data and AAL claims its own moral belief, that technology will improve the quality of life of elderly people in terms of health, safety, autonomy, and participation. Furthermore, it is supposed to have positive impact on national economy and research & development institutions. For these reasons, according to the promoters of AAL, the outlined technological efforts should be undertaken and are, indeed, without reasonable alternative. This seemingly impossibly ambitious venture requires sound empirical research and further ethical scrutiny in terms of individuals whose motivation, cooperation and collaboration as active citizens or patients are necessary. This research is also needed regarding the effects on society itself, which this notion would see transformed into an entity of ubiquitous and permanent surveillance, where digital data seem to become the most valued currency. Simply put, people become the object of biopolitics that is presumably rooted in a new form of benevolent paternalism (nudging). In the following chapter, we will view Big Data and ambient assistant living through the lens of the Foucaultian concept of biopolitics.

Big Data and AAL as a new form of biopolitics

We start off with a short description of the central tenets that constitute the Foucaultian idea of governing and managing the life of human individuals as well as human population by means of technologies of power, technologies of the self and biopolitical strategies deployed in order to shape the conduct of life – individual or collective. Biopolitics according to Foucault is basically the art of guiding, educating and administering individuals and collectives by means of specific knowledge based technologies. All of them are, in one way or another, *technologies of power*, i.e., they constitute asymmetrical social relations between those who exert and those who are subject to power, although these power relations may not be visible. Foucault furthermore makes an analytical distinction regarding the fact that governmentality refers either to the individual or to a population, defined and segmented according to knowledge-based criteria. (1) In view of the former, technologies of power discipline, order, educate and control embodied human subjects. Although Foucault is not always entirely clear on this point, these technologies of power are to be conceived as enabling mechanisms. They constitute, form and configure the subjects according to the desires and interests by those in power or respective positions. In his later work, Foucault introduces the concept of technologies of the self. These are mechanism of power that introduce capacities for self-education and capabilities for self-management. Biopower and biopolitics, distinct from (repressive) sovereign and legal instruments of power and domination, is a comparatively recent form of administering and governing human individuals and collectives (Foucault 1983). As Foucault has shown, the modern state and its various agencies have increasingly focused on life (*bios*) as a central resource of power (Foucault 1983, 2005; Foucault et al. 1993). Biopower and biopolitics became decisive mechanisms of forming and transforming *subjects*, their bodily features, body techniques, complex practices and everyday routines (Foucault 1983; see also Lemke 2007). Yet, biopolitics not only targets the individual human body and its capabilities and performances, but also defines and categorizes population or sub-segments to be governed. In the 19th and 20th century, the emerging health sector, e.g., the different hygiene policies of modern states, became a core arena of the politics of life (Foucault 1996). The development and expansion of biopolitics goes hand in hand with the growing scientification of modern societies. In fact, scientific knowledge is the main resource for the constitution and legitimation of biopolitical strategies and their objectives. Foucault's main point, however, is hardly to show that health policy has become a separate field of politics. Rather it is to underscore that by invoking health, biopolitics has permeated more and more societal fields, collective practices as well as individual routines in everyday life. Some even believe that the modern subject is in various respects a product of health related forms of biopolitics (Sarasin 2001).

(2) Populations or subpopulations first need to be identified and classified in order to become a malleable subject of technologies of power and biopolitical strategies. It has become a rather common view to allege that (neo-)liberal societies have intensified and expanded the politics of life, be it to reshape the lifestyle of societal subpopulations, as in the cases of obesity and alcoholism, or to govern more and more bodily aspects and biological dispositions on genetic and molecular levels (Rose 2007; Lemke 2000). Thus, one could maintain that the Big Data-based AAL project is simply another case of modern biopolitics, focusing on specific subpopulations to which certain features are ascribed by means of (evidence-based) scientific knowledge.

Even though the all-encompassing application of Big Data in AAL at least in its interconnected form is still (promising) science fiction, many research projects have begun to move in this direction. Thus, looking at the emerging field of data-based and -driven ambient technologies at an early stage makes for an interesting topic of social scientific and ethical investigation. Also, the promise of enhancing the quality of life of an aging population is not only a highly legitimate consideration, but also a resource for gaining research funds and economic return. What is the central concept behind the science based political economy of good life in AAL sites?

Data driven biopolitics of body, space and population

What insights may be achieved looking upon Big Data in AAL from a Foucaultian perspective? Though a general trend toward Big Data in rapidly globalizing societies can hardly be disavowed, one first has to acknowledge that Big Data in AAL residences, at least in Germany, is more a technological vision than reality. At the same

time, it invokes the values of modern liberal societies, such as autonomy, health, safety and the right to a self-reliant life. In this sense, one could even literally speak of a “moral economy” (Fassin 2005) of data based ambient living as a biopolitical conduct of conducts. Big Data in AAL offers a technological solution that seems to reconcile societal needs in terms of demographic pressure, the core values of liberal society and its guiding principle of a long, independent and healthy life as well as the interest and demands of a variety of social actors. In the following we list a few crucial issues that characterize the concept of Big Data in AAL that should be focused on in further public deliberation.

(1) Knowledge production: a first issue that needs further discussion are the characteristics of *digital knowledge production* itself. To be able to cope with self-set tasks, Big Data biopolitics must be multidirectional in character, not only in regard to the technological infrastructure required but also the coordination of actors involved in AAL projects, starting from caregivers, physicians, relatives, online-services, call centers, transport services and the residents themselves. With regard to the *individual*, we must explore the way Big Data based AAL projects target and shape the human body by asking what kind and quality of data is typically processed. To the extent that the individual's body is in the center of Big Data in AAL, biopolitics is clearly a form of politics of life, addressing both the *zoë* (biological life) and the *bios* (political life). With respect to the former, all vital data which related to disease, illness) and health are of major interest for data processing including the subsequent decision making, diagnosis and therapeutical strategies. We do not know much about the truth games and the ways future “raw data” (which in itself might be a very misleading term) will be aggregated, how the vital parameters will be categorized, by whom and for what reasons and to what ends. This affects especially the highly malleable modes of sorting information in or out. Neither do we know much about what kind of academic knowledge concepts will feed and shape the process of knowledge production, configuration and categorization. Third, we know even less about the (economic and health-political) interests of the actors (care providers, etc.) who will translate these scientific knowledge patterns into action. All in all these are vitals concerns of a democratic society which should be deliberated publicly and on time.

With regard to the organization of space, it is clear that Big Data governmentality does not end at the boundaries of the individual human body; instead, it has an eye on the practices the individual is embedded in. ICT in AAL also allow for the large surveillance of residential spaces and adjacent areas by means of context sensitive motion sensors, gateways, wearable technologies or web-based devices which passively monitor or actively instruct the user. With respect to this AAL extends surveillance to the entire living situation of elderly residents or disabled citizens. This will make the consensus of users necessary which tends to be more than a complex task. Big Data is at the same time opening up and promising opportunities by means of collecting data on body and space while introducing data generating devices in the lived spaces (as well as in and on bodies) and thereby shaping these spaces people live and move in.

This is not only a question of data safety in databases, clouds or on platforms and networks as such, but also concerns the say of the clients that in reality provide their private data to contribute to scientific knowledge production. Thus, besides safety related questions the topic of appropriate participation occurs, since AAL de facto transforms private residences into living labs. Big Data producer can hardly be conceived as an impartial and disinterested provider of evidence-based knowledge whose only intention is to enhance and maintain AAL user's health status. What is happening or will happen in Big Data based AAL projects is the performance of what Krohn/Groß/Hoffmann-Riem (2005) call real life experiments that is scientific experiments carried beyond the laboratory walls. With respect to that we have to take into account that Big Data in AAL is a powerful science based real life experiment. The embodied individuals are by no means mere clients of health care services. They are – wittingly or not – the subjects of research and knowledge production, a “privilege” they even have to pay for.

(2) Normalization and scientification: Big Data is a new biopolitical strategy that leads to an increased scientification of everyday life, but still, taking the example of contemporary health apps, there is also a considerable chance that it will oscillate between science and pseudo-scientific gamification and infotainment. Among the central problems are thus the quality and accountability of data and the processes of data mining and aggregation, the relevance of the categories in use, and the quality of the conclusions drawn from the data stocks by caregivers, insurance companies, health policy, public and private services, housing companies, the individual user and their relatives. It can also be expected that Big Data based biopolitics will cause a further

standardization of health/disease concepts and lifestyle or activity profiles. Big Data, in this sense, may lead to an enhanced process of normalization in future (Link 2013), i.e., it will enhance the process of creating images of the "normal human body" by means of aggregated statistical data from multiple sources. In order to do so, residents in AAL sites need to be equipped with sophisticated monitoring and communication devices that generate appropriate data streams. It will be of interest to see which kind of data will be really collected and used in future and why. No Big Data in AAL infrastructure can function beyond the categories established by the (bio-)medical and scientific concepts, practices and institutions they serve. Therefore, one has to carefully scrutinize and evaluate which kind of concepts of disease, illness and health will be used to select, aggregate and interpret Big Data records. Biopolitics, and here we follow Fassin (2005), always has a normative element. A normative rationale is also inherent in the scientific concepts used by (private) care providers, physicians as well as health policymakers. This poses the question: what are the consequences of standardizing and typifying health profiles, be it vital parameter clusters or personal activity patterns or collective habits, routines and practices? How can the extensive datafication of everyday life be legitimized?

(3) Virtual duplicate: a third important issue seems to be the fact that Big Data allows for a doubling of identities. Big Data is obviously based on real-life-persons. But beyond these identities we now have to deal with another identity, the digital duplicate created by Big Data. This is what Cheney-Lippold (2011) has coined an "algorithmic identity" which is the construction of net-based soft biopolitics as a new form of conduct of conducts. Besides questions of privacy, liability and data security, the more fundamental question of the form of subjectivity involved in regimes of algorithmic governmentality occurs. Big Data streams allow for the constitution of a *digital other* that informs, mirrors or shapes the flesh-and-blood selves of the citizens which is very difficult to interpret independently. This data can or even should be used by the resident for self-observation and reflection. In this sense, Big Data provides concepts for "technologies of the self" (Foucault). We expect the virtual body to become a central instrument of biopolitics inasmuch as it allows for a (popular) science-based *normalization* (Link 2013) of aging bodies. This virtual duplicate is presumably not fully visible or even accessible at all to the user. It seems to lead its own life, which is in fact a misleading idea provided that there is somebody who has full access and full control of the data. The emergence of the virtual duplicate is an ambivalent category, a mirror and means of self-inspection and self-monitoring, but it is also a new source of power and – legally speaking – a threat to the right to informational self-determination.

(4) Categorization of collectives: Big Data seemingly offers new opportunities for the definition, (re-)categorization, medicalization and politicization of specific (sub-)populations which can be classified and even treated as deviant. The surveillance and the monitoring of health related routines, movement profiles and nutritional habits of these collectivities becomes a further focus of algorithmic biopolitics. The crucial question is how Big Data mining and aggregation works in regard to the construction of health and lifestyle-related patterns? According to which criteria will a differentiation between an appropriate and a socially unacceptable (and potentially punishable) lifestyle be made? We assume the ways vital parameters digitally constructed of group members, the respective embodied person, (digital and real) surroundings, devices and collective actors will be interconnected to become a central source of biopower. Whether this will be a source of individual empowerment or control and subjugation is an empirical question to be answered by future developments and research.

(5) Transparency and data security: fifth issue to be addressed is the transparency and safety of data related to the storage, circulation and its accessibility. Big Data provides information about everyday life and thus expands control over the entire lifestyle. The benefits promoters of AAL projects expect significant changes in the health status of citizens. Big Data generated by sensor data and their visualization is supposed to provide a better basis for medical decision and forms a necessary prerequisite for future telemedical settings (Jacobson et al. 2013). With regard to this Knaup and Schöpe (2014: 150) assume that the provision of surveillance data from residential areas to physicians and care providers may need standardized communication technologies and specific organizational entities in order to manage the huge amounts of data, such as telemedical centers. On the other hand, using computer and web-based devices requires at least some appropriate training on the side of senior or disabled citizens. Another benefit alleged concerns the advantages of Big Data for the establishment of large scale (regional) health information centers (Gietzelt et al. 2014). Integrated sensor based networks in AAL are no longer document-based and provide continuous data streams, but the integration of multiple sensor data requires sophisticated coding, models and methods for interpreting, standardizing and

contextualizing the home site data. What holds true for the constant monitoring of vital data on individual bodies is also true for the permanent surveillance of home sites and adjacent areas. The emerging forms of biopolitics in AAL are based on algorithms, but they also seem to require new institutional forms of processing, managing and storing data. This raises the questions of data protection, transparency and legitimate access to personal data. Both the individual embodied persons and their habits and lifestyle get a digital companion with his own history. Who has legitimate access to data, profiles and why?

(6) Last but not least, the question whether the AAL really enhances the autonomy of the aging or disabled citizens should be raised in the context of governmentality (Helbing et al. 2015). Therefore, the focus should be concentrated not only on the flesh-and-blood subject and populations but also on the technological, organizational and institutional infrastructures AAL residents live in. Although AAL is considered to be rooted in the voluntary cooperation of users with service providers and administrative bodies, the new forms of permanent monitoring of life and lifestyles might also create illusions of autonomy. One could ask: to what extent and with which consequence is there a benevolent paternalism at work in algorithmic governmentality and its increasing possibilities of governing at distance? *Algorithmic governmentality* focusses on the remote monitoring of the individual body, the personal or group-related lifestyle and the residential spaces citizens in need of (technological) support live in. Big Data in this respect presumably constitutes a form of soft biopolitics exercising a benevolent control over individuals or populations. This emerging benevolent paternalism is grounded in a "moral economy" invoking the ethos of a good life. However, if the algorithmic governmentality appears to be a benevolent one, why then should one take issue with the concept at all? To put it bluntly: Big Data biopolitics, donning its benevolent digital furs, tends to camouflage the power relations it implies. In this regard, the topic of legitimization and control by non-political authorities and organizational bodies should not be neglected. With respect to the Big Data generated technologies of the self which inform senior citizens about the perils of their individual lifestyle or what they must take notice of in and around their living space, it can at least be doubted whether the individual, as Cheney-Lippold (2011: 176) puts it, is capable of "really experiencing the effect that algorithms have in determining one's life". The naturalization of technological environments in AAL residential sites camouflages the fact that a multitude of (organizational) actors in distant locations contribute to the calculations, cybernetic categorizations and (medical) decision-making. The task is to acknowledge and make subject of discussion the networks of power senior residents and other needy citizens live in. What is therefore necessary is an open ethical reflection on the implications, possible (side-) effects and consequences of the biopolitics of Big Data in AAL projects at this early stage of technology development and implementation.

Conclusion: Towards a technology-based moral economy of life and lifestyle?

We have discussed the possible impact of Big Data in AAL on the individual body as well as on collectivities. The use of Big Data and smart information technologies in homes and wider residential areas constitute a new form of biopolitics which on the one hand actively involves individual embodied persons, and on the other hand constitutes new collectivities to which physicians, health care providers, public managers and political decision-makers attribute information and data which characterize them as deviant from parameters and margins set by statistical normal distribution curves. They consequently become subjects of major interest for health care providers, public services, administrators and bioscience as well. What is more, they also become subjects of (permanent) surveillance and intervention while 'living in a lab' wittingly or unwittingly. We have therefore pointed out that Big Data in AAL can be comprehended as a further step in the scientification and datafication of everyday life. The implementation of in-home and mobile sensor networks allows for a provision of continuous data streams that feed the data banks of individual care providers as well as organizational entities. All in all, this will constitute a vulnerable infrastructure filled up with intimate data which will awaken covetous motives among insurance-companies, employers etc. The generation and storage of Big Data in AAL leads to what we call a digital duplicate, a virtual copy of embodied persons based on sophisticated, standardized communication technologies. In this sense, Big Data and coded computer algorithms do not only allow for a sophisticated modulation of control, but contribute to a further *normalization* (Link 2013) by making use of

seemingly private vital data as well as information on everyday routines and of citizens in private households and larger residential areas. But isn't there more to Big Data / algorithmic biopolitics?

Though datafication of AAL goes hand in hand with normalization, permanent surveillance and the creation of a virtual duplicate, however, this view on biopolitics still underscores the strong moral and ethical implications lying behind the idea of AAL. It seems important to us to raise the question whether the blend of Big Data and AAL can be seen as a digital moral economy of lifestyle. This is, as Fassin (2005) puts it, a subtle way of governing human bodies and lifestyles by making health and bodily integrity the core values of legitimation. The individuals and sub-populations are not only asked to take care of their own body and well-being, they need to do so for the well-being of the community and society. Big Data in AAL could be an interesting case to show that we are moving from a politics of life itself to a sophisticated science-based moral economy of good life based on the health and the promises of permanent autonomy. However, this still is a form of conduct of conducts imposed by the Big Data driven biopolitics, even if this occurs in subtle ways.

References

- Cheney-Lippold, John: *A New Algorithmic Identity. Soft Biopolitics and the Modulation of Control*. In: *Theory, Culture & Society* 2011, Vol. 28 (6), S. 164-181
- Demiris, George: *Smart homes and ambient assisted living in an aging society. New opportunities and challenges for biomedical informatics*. In: *Methods of Information in Medicine* 2008, 47 (1), 56-57
- Demiris, George/Thompson, Hilaire: *Smart homes and ambient assisted living applications: from data to knowledge-empowering or overwhelming older adults? Contribution of the IMIA Smart Homes and Ambient Assisted Living Working Group*. *IMIA Yearbook of Medical Informatics* 2011, 6(1), 51-57
- Driscoll, Kevin: *From Punched Cards to Big Data: A social History of Database Populism*. In: *communication +1* 2012, Vol. 1, Article 4, <http://scholarworks.umass.edu/cpo/vol1/iss1/4/>. (accessible 20.01.2016)
- Fassin, Didier: *Compassion and Repression: The Moral Economy of Immigration Politics in France*. In: *Cultural Anthropology* 2005, Vol. 20, Issue 3, 362-387
- Foucault, Michel: *Der Wille zum Wissen. Sexualität und Wahrheit 1*. Frankfurt am Main, Suhrkamp 1983
- Foucault, Michel: *Die Politik der Gesundheit im 18. Jahrhundert*. In: *Österreichische Zeitschrift für Geschichtswissenschaften* 1996. 7. Jg. Heft 3, Kulturen der Krankheit, S. 311-326
- Foucault, Michel: *Analytik der Macht*. Frankfurt am Main, Suhrkamp 2005
- Foucault, Michel/Martin,Rux/Martin, Luther H./Paden, William E./Rothwell, Kenneth S./Gutman, Huck/Hutton, Patrick H.: *Technologien des Selbst*. Frankfurt am Main, Fischer 1993
- Gietzelt, Matthias/von Bargaen, Tobias/Kohlmann, Martin/Marschollek, Michael/Schwartz, Jonas/Song, B./Wagner, M./Wolf, Klaus-Hendrik/Haux, Reinhold: *Home-centered Health-enabling Technologies and Regional Health Information Systems – An Integration Approach Based on International Standards*. *Methods of Information in Medicine* 2014, 53(3), 160-166
- Groves, Peter/Kayyali, Basel/Knott, David/Van Kuiken, Steve: *The Big Data revolution in healthcare. Accelerating value and innovation*. Center for US Health System Reform, Business Technology Office, New York, McKnisey&Company 2013
- Helbing, Dirk/Frey Bruno S./Gigerenzer, Gerd/Hafen, Ernst/Hagner Michael/Hofstetter Yvonne/van den Hoven, Jeroen/Zicari, Roberto V./Zwitter, Andrej, *T-Revolution: Digitale Demokratie statt Datendiktatur. Big Data, Nudging, Verhaltenssteuerung: Droht uns die Automatisierung der Gesellschaft durch Algorithmen und künstliche Intelligenz? Ein gemeinsamer Appell zur Sicherung von Freiheit und Demokratie*, Spektrum 17.12.2015
- Hilbe, Johannes/Schulc, Eva/Lindner, Barbara/Them, Christa: *Development and alarm threshold evaluation of a side rail integrated sensor technology for the prevention of falls*. In: *International Journal for Medical Informatics* 2010, 79(3), 173-180

- Jakobsen, Anna S./Laursen, Lars C./Ostergaard, Birte/ Rydahl-Hansen, Susan/Phanareth, Klaus V.: *Hospital-admitted COPD patients treated at home using telemedicine technology in The Virtual Hospital Trial: methods of randomized effectiveness trial*. In: *Trials* 2013, 14(1), 280
- Knaup, Petra./Schöpe, Lothar *Using Data from Ambient Assisted Living and Smart Homes in Electronic Health Records*. In: *Methods of Information in Medicine* 3/2014, 149-151.
- Koselleck, Reinhart: *Erfahrungsraum und Erwartungshorizont – zwei historische Kategorien*. In: Koselleck, Reinhart. *Vergangene Zukunft. Zur Semantik geschichtlicher Zeiten*. Frankfurt/Main, Suhrkamp 1989, 349–375
- Krohn, Wolfgang/Groß, Matthias/Hoffmann-Riem, Holger: *Realexperimente. Ökologische Gestaltungsprozesse in der Wissensgesellschaft*. Bielefeld, transcript 2005
- Lemke, Thomas: *Die Regierung der Risiken. Von der Eugenik zur genetischen Gouvernamentalität*. In: Ulrich Bröckling/Susanne Krasmann/Thomas Lemke (Hrsg.), *Gouvernamentalität der Gegenwart*. Frankfurt am Main, Suhrkamp 2000, S. 227-264
- Lemke, Thomas: *Biopolitik zur Einführung*. Hamburg: Junius 2007
- Leone, Alessandro/Diraco, Giovanni/Siciliano, Pietro: *Detecting falls with 3D range camera in ambient assisted living applications: a preliminary study*. In: *Med. Eng. Phys.* 2011, 33 (6), 770-781
- Link, Jürgen: *Versuch über den Normalismus. Wie Normalität produziert wird*. Göttingen, Vandenhoeck & Ruprecht 2013
- Lupton, Deborah: *Self-tracking Modes: Self-Monitoring and Data Practices*. 'Imminent Citizenship: Personhood and Identity Politics in the Informatic Age' workshop, Canberra, Australia, August 27th 2014
- Manzeschke, Arne/Weber, Karsten/Rother, Elisabeth/Fangerau, Heiner: *Results of the study »Ethical questions in the area of age-appropriate assisting systems«*, Berlin 2015
- Nitzsche, Thomas/Thiele, S./Häber, Anke/Winter, Alfred: *Communication Architecture for AAL – Supporting Patient Care by Health Care Providers in AAL-enhanced Living Quarters*. In: *Methods Inf Med* 2014, 53(3), 167-174
- Reeder, Blaine/Chung, J./Le, T./Thompson, Hilaire/Demiris, George: *Assessing Older Adults' Perceptions of Sensor Data and Designing Visual Displays for Ambient Environments*. In: *Methods of Information in Medicine* 2014, 53(3), 152-159
- Rose, Nicolas: *The Politics of Life Itself. Biomedicine, Power, and Subjectivity in the Twenty-First Century*. Princeton/Oxford, Princeton University Press 2007
- Sarasin, Phillip: *Reizbare Maschinen. Eine Geschichte des Körpers 1765-1914*. Frankfurt am Main, Suhrkamp 2001
- Schmidt, Silke/Rienhoff, Otto: *Interdisciplinary Assessment of Permanent Health Monitoring*, Amsterdam/Berlin//Tokyo/Washington DC: IOS-Press 2012
- Spitalewsky, Katharina/Rochon, J./Ganzinger, Matthias/Knaup, Petra: *Potentials and requirements of IT for ambient assisted living technologies. Results of a Delphi study*. In: *Methods of Information in Medicine* 2013, 52(3), 231-238
- TAB (Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag): *Schwerpunkt: Hope-, Hype- und Fear-Technologien*. TAB-Brief 39/2011
- van Dijck, José: *Datafication, dataism and dataveillance: Big Data between scientific paradigm and ideology*. In: *Surveillance & Society* 2014, 12(2), 197-208
- Vimarlund, Vivian/Wass, S.: *Big Data, Smart Homes and Ambient Assisted Living*. In: *IMIA Yearbook of Medical Informatics* 2014, 143-149
- Weber, Max: *Die protestantische Ethik I. Eine Aufsatzsammlung*. Gütersloh, J.C.B. Mohr (Paul Siebeck) 1981
- Weingart, Peter: *Verwissenschaftlichung der Gesellschaft - Politisierung der Wissenschaft*. In: *Zeitschrift für Soziologie* Jg. 12, Heft 3 (1983), 225-241
- Wichert, Reiner/Klausning, Helmut (Hrsg.): *Ambient Assisted Living: 7. AAL-Kongress 2014 Berlin, Germany, January 21-22 2014*. Heidelberg/New York/Dordrecht/London, Springer 2015
- Zwitter, Andrej J./Hadfield, Amelia: *Governing Big Data*. In: *Politics and Governance* 2014, Vol. 2, Issue 1, 1-3