Introduction

Digital Materialism

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Recent technological developments and imaginaries oscillate between the idea of superfluous materiality and the digital pervasion of everyday objects. Users are increasingly surrounded by smart objects, equipped with digital logic and sensor technologies. Devices connected as learning machines to the 'Internet of Things' aim at being ubiquitous, but imperceptible elements of users' daily lives. At the same time, cloud computing renders necessary hardware increasingly invisible and abstract to individual customers. A 'naturalisation' of technological material and an alleged disappearance of hardware[1] are part of a future imaginary in which progress is measured against digital technology's minimal material intervention in human practices and environments. Similarly, in popular culture, techno-human relations are often described as issues of materiality. When the first *Matrix* movie came out in 1999, it evoked a future scenario in which machines control the world, reducing humans to material energy sources (see also Harris/Taylor 2005: Preface). In 2013, Spike Jonze's science fiction comedy-drama *Her* told a very different story: it described a future in which artificial intelligence programmes become so bored and frustrated with humanity that they simply leave planet earth and all its material conditions behind.

These technological developments and imaginaries come along with digital media research which is increasingly concerned with questions of materiality. Such an interest in the material features, conditions and affordances of digital media can be seen as "[...] a reaction to the myth of the immaterial, rather than pointing to an actual immaterialization of culture" (van den Boomen et al. 2009: 10). The realisation that we are merely dealing with a myth is crucial, since it also conceals the methodological challenge that the material aspects of digital media are not only increasingly invisible to users, but may also become more difficult to access for researchers.

1 Already by 1995, Friedrich Kittler had described a similar effect with regards to software: "[T]he so-called philosophy of the computer community tends to systematically obscure hardware by software, electronic signifiers by interfaces between formal and everyday languages. In all philanthropic sincerity, high-level programming manuals caution against the psychopathological risks of writing assembler code. In all friendliness, 'BIOS services' are currently defined as 'hid[ing] the details of controlling the underlying hardware from your program.' Consequently, in a perfect gradualism, DOS services would hide the BIOS, WordPerfect the operating system, and so on and so on [...]" (Kittler 1995; referring to Barkalati 1989).

DOI 10.14361/dcs-2015-0102

Recent (neo)materialist approaches to media research and theory have emphasised the relevance of materiality and the non-human, particularly with regards to inorganic matter. Ultimately, a *new materialism* is concerned with *things* and their *doings*. It addresses "[...] even non-solid things. Such real but weird materialities [...] are not only touchable objects, but also modulations of electrical, magnetic, and light energies, in which also power is nowadays embedded" (Parikka 2012: 96). Hence, it suggests looking at phenomena which do in fact not comply with our common-sense understanding of matter: it rejects a conception of materiality which is solely based on the fact that humans may touch, feel, see, or hear a sensation without mediation. This understanding of matter recognises "[...] digital materiality, not so much as 'im/material' but rather as 'in-material' [...] as stuff which may defy physical contact yet which is incorporated in materiality [...]" (van den Boomen et al. 2009: 9). Although we may not be aware of certain media materialities, (digital) technologies and their constituting elements exert agency, affect industries and individuals.

With regards to media research, the ecologically oriented *new materialist paradigm* is part of a broader movement which emphasises the relevance of technological materiality – and has even been described as 'material turn' (see, e.g. Hondros 2015 [forthcoming]; Apperley/Jayemane 2012; Kitzmann 2006). In addition to the new materialist approach (Cubitt 2014; Goddard 2014; Parikka 2012, 2015; Taffel 2012) and media ecologies (Cubitt 2005; Fuller 2005), one can identify various research lines in the field of 'digital materialism': the 'Berlin school of media studies' and the influential work of Friedrich Kittler, software and critical code studies (Berry 2011; Chun 2008; Fuller 2003, 2008; Manovich 2001, 2013), literary critique of electronic texts (Hayles 2002, 2004) and forensic materialism (Kirschenbaum 2008), and Marxist media research (for overviews of these fields see, e.g. Casemajor 2015 [forthcoming]; van den Boomen 2014).

In this introduction to the first *Digital Culture & Society* issue on "Digital Material/ism", we will particularly focus on the new materialist approach, its relation to the Berlin school of media studies, software studies and the forensic approach.[2] In the following sections, we will introduce these research fields and subsequently summarise the papers presented in this issue. While it is unquestionable that 'digital materialism' refers to a multiplicity of diverse approaches, we are interested in pointing out shared motivations and motives which bind them together as 'media materialist' approaches.

2 The history of materialism as a (multifaceted) philosophical line of thought will be largely neglected in this introduction. Since this issue focuses on the relevance of materiality and materialism for digital media research, we will focus on publications/authors which have contributed to this specific field.

New Materialism

During the late 1990s, the concept of a *new materialism* was first explicitly articulated by Manuel DeLanda and Rosi Braidotti. In his article "The Geology of Morals, A Neo-Materialist Interpretation" (1996), DeLanda suggests the notion of "neo-materialism" in the context of his interpretation of Deleuze and Guattari's philosophy. He proposes the approach as

> "[...] a philosophical stance which rejects ideas of progress not only in human history but in natural history as well. Living creatures, according to this stance, are in no way 'better' than rocks. Indeed, in a nonlinear world in which the same basic processes of self-organization take place in the mineral, organic and cultural spheres, perhaps rocks hold some of the keys to understand sedimentary humanity, igneous humanity and all their mixtures." (DeLanda 1996)

Likewise referring to Deleuze, Braidotti describes his thinking as a perspective which re-emphasises the materiality of the bodily self. According to the feminist theorist and philosopher, Deleuze proposes "[...] a form of neo-materialism and a blend of vitalism that is attuned to the technological era. Thinking through the body, and not in a flight away from it, means confronting boundaries and limitations" (Braidotti 2000: 160). For Braidotti as well as DeLanda, a *neo-materialism* aims at overcoming persistent, post-modern dualisms and methodologically "[...] starts its analysis from how these oppositions (between nature and culture, matter and mind, the human and the inhuman) are produced in action itself" (Dolphijn/van der Tuin 2012).[3]

Already by 2012, Dolphijn and van der Tuin had claimed that "[i]n terms of academic attention, new materialism is in many ways a wave approaching its crest" (ibid.). While quite rightly pointing out the history of an allegedly 'new' materialism, this statement also suggests that we might be looking at a temporary fashion. Instead however, this journal issue aims to stress and promote *digital materialism* as a sustainable field of media research which "[...] has to be invented continuously anew" (Parikka 2012: 98). While the term comprises a variety of approaches and opens up associations to various research traditions, 'new media materialist' approaches seem to be rooted in similar motivations: to search for and to address blind spots in media research. They share the aim of avoiding analysing media as products (as what users/consumers are supposed to perceive them) and they move beyond questions of representation. Rather than looking at what happens on the screen and hence concentrating on the represen-

3 See also van den Boomen (2014): "The declaration of a new materialism is always timely. Whether called material semiotics (Law and Mol 1995), transmateriality (Whitelaw 2008), or new materialism (Van der Tuin and Dolphijn 2010), the aim is to formulate an onto-epistemology that is non-essentialist, non-deterministic, non-transcendent, non-Cartesian, non-dichotomic, non-dialectical, non-idealistic, non-representationalist, non-teleological, non-reifying, non-metaphysical, non-reductionist, and non-universalist. Indeed, there are a lot of pitfalls to avoid." (ibid.: 154)

tative, accessible side of digital media, the focus shifts to what happens 'behind the screen' and to dynamics which happen before and after media's representative societal function. This perspective sheds light on the interplay between non-human and human actors involved in media production and consumption dynamics. Such approaches form an interdisciplinary research field with contributions from i.a. science and technology studies, gender studies, media studies and philosophy.

While often starting from a micro-perspective and looking at the material form/s of digital media, new materialist approaches have been particularly vocal in pointing out their (ecological) affordances, e.g. under which conditions media are produced, used and ultimately disposed of. This also implies a necessity to critically engage with political, economic and socio-cultural dynamics. Technological agency is not just understood as a neutral factor to be rationalised and described, but as a potentially harmful force in globalised economies and politics. Material and discursive aspects are not treated separately, but material is acknowledged as a discursive, meaning-making agent.[4] Such approaches are on the one hand motivated by a rejection of the aforementioned dualisms and are critical of an over-emphasis on language and forms of cultural representation in the humanities and social sciences. In her elaboration on a posthumanist notion of performativity, Karen Barad stated that

> "[…] discursive practices are not human-based activities but rather specific material (re)configurings of the world through which local determinations of boundaries, properties, and meanings are differentially enacted. And matter is not a fixed essence; rather, matter is substance in its intra-active becoming – not a thing but a doing, a congealing of agency." (Barad 2003: 828)

Barad's work refers to Butler's notion of "materialization" – which proposes to understand matter "not as site or surface, but as a process of materialization that stabilizes over time to produce the effect of boundary, fixity and surface we call matter" (Butler 1993: 9) – and to Haraway's concept of "materialized reconfiguration" which links "stories, desires, reasons, and material worlds" (Haraway 1997: 64).[5]

4 A similar aim was also decisive for the development of actor network theory as "[…] disparate family of material-semiotic tools, sensibilities, and methods of analysis […]" (Law 2009: 141). While Barad stresses the relevance of discursive practices as material (re)arrangements, Law refers to ANT as 'material-semiotic approach' which "describes the enactment of materially and discursively heterogeneous relations that produce and reshuffle all kinds of actors including objects, subjects, human beings, machines, animals, 'nature,' ideas, organizations, inequalities, scale and sizes, and geographical arrangements" (ibid.).

5 Such an emphasis on an artificial separation between matter and discourse is also notable in the context of ecocriticism within which a new materialist framework accounts for "a more integral understanding of matter and discourse" (Oppermann 2013: 55).

These early accounts of new materialism were mainly linked to feminist technoscience. During the 2000s, further approaches within digital media studies emerged. Matthew Fuller's *Media Ecologies* can be seen as early attempt in media studies to acknowledge the development (and methodological challenge) "[...] that objects have explicitly become informational as much as physical but without losing any of their fundamental materiality" (Fuller 2005: 2). His work addresses the "the massive and dynamic interrelation of processes and objects, beings and things, patterns and matter" (ibid.). Based on i.a. investigations of the London-based Pirate Radio (e.g. with regards to used technologies such as transmitters, studio sites, records, dub plates and participants' modes of operation), photography and media art, Fuller maps out the dynamics and interdependencies of material systems and cultural practices.

In 2012, Parikka proposed "new materialism as media theory" (ibid.: 98) and as a research method which "takes an intensive look inside the machines [...] and at the networks in which machines are being compiled and discarded" (ibid.: 97). His recent publication *A Geology of Media* (2015) expands on these ideas and describes media research as 'study of components'. Instead of analysing media as products, Parikka suggests investigating media before and after they are used as functional, representative objects. Like many other approaches in the field of digital materialism, Parikka draws on the work of Friedrich Kittler and his emphasis on the 'descent from software to hardware' (Kittler 1995). While Kittler insisted on the necessity of understanding the hardware elements enabling digital media, Parikka pushes this approach even further. For him, it is not only relevant to analyse how technological components function, but by what kind of non-human, inorganic elements they are enabled. His work illustrates the ecological affordances, inequalities and health risks of digital technology production and disposal. In this sense, he focuses on media's material (metallic, mineral, chemical) constituents in their political, economic and ecological contexts. Parikka's approach is described and discussed in more detail in the interview presented in this issue.

In *A Geology of Media*, the media theorist mainly focuses on inorganic matters enabling digital technology and the affordances of hardware production. However, he frames his approach as "one particular possibility of 'new' materialism" (Parikka 2012: 97) which is inspired by a methodology of 'descent' in software studies, tracking the "continuous relation from the symbol functions on higher levels of coding practices to voltage differences as a 'lower hardware level'" (ibid.).

Software/Critical Code Studies

In his paper "Es gibt keine Software" (1993) ("There is no software", 1995), Friedrich Kittler presented the provocative idea that software was simply a figment of our imagination, obscuring our view of what is actually relevant: the hardware. He proposed that hardware was the crucial, material fundament of computer-mediated communication and human 'world-appropriation'. For a long time, Kittler's theory was promoted as a basic principle of media studies. One might be inclined

to argue that the juxtaposition of 'materiality' and 'immateriality' advocated in the aforementioned paper is to blame for the fact that aspects of software have received only little attention in cultural and media studies in subsequent years.

However, 10 years after Kittler's seminal paper, a series of publications objected the concept of immaterial software (Manovich 2001; Fuller 2003; Hayles 2004: 67-90). Contrary to the widespread opinion, software was granted a certain materiality that was said to manifest itself, and to be influential, on various levels (Chun 2008: 299-324). The conceptual and technological fundaments of the computer and the particular characteristics of algorithms, programming languages, and interfaces are now at the centre of attention in numerous studies (Galloway 2004, 2006). One of the main questions is: What forms of programmability and usage can they facilitate and what effects can the use of different informatics concepts have in 'everyday life' (Kitchin/Dodge 2011), in mobile user cultures (Miller/Matviyenko 2014), for digital storytelling (Wardrip-Fruin 2011), or for a societal diagnosis of our time (Mackenzie 2006; Berry 2011).[6] In this respect, *software studies* are media materialist approaches but are also part of media archaeology and cultural history, since they understand software as something that has its own history and agency. Moreover, it is not only defined by media technology, but to the same extent by social, institutional and cultural conditions.

A plurality of research institutions have served as theoretical and methodical 'instigators' of *software studies*, as their research objects are integrated into a variety of fields of application. For example, industrial designers, anthropologist, human biologists, architects, sociolinguists, information scientists and representatives of science and technology studies have investigated the status of collective systems of writing, language, images and memories in common projects, which have then been produced, processed and subjected to statistical analysis by computer-based codes, standards, protocols, programs, data processing systems and databases (Fuller 2008).

Today, the field of *software studies* has become much more differentiated, and various kinds of entanglements between software, culture and society are examined. Since 2011, MIT Press has published the *Software Studies* series; in the same year, the journal *Computational Culture* was established, which traces the interdependencies between software and everyday life:

"In order to understand digital objects such as corporate software, search engines, medical databases or to enquire into the use of mobile phones, social networks, dating, games, financial systems or political crises, a detailed analysis of software cannot be avoided." (cf. http://computationalculture.net/)

6 "Over the past thirty years, the practices of everyday life have become increasingly infused with and mediated by software. Such are the capacities and growing pervasiveness of software that it has become the lifeblood of today's emerging information society, just as steam was at the start of the industrial age. Software, like steam once did, is shaping our world – from the launch of billion-dollar spacecraft to more mundane work such as measuring and displaying time, controlling traffic lights, and monitoring the washing of clothes." (Kitchin/Dodge 2011: 3).

These publication projects can be seen as indicators of new research questions concerning the interplay between social formations, forms of knowledge and programmed machines that have emerged from the transdisciplinary occupation with software.

Forensic Materialism

In his well-known book, *Mechanisms: New Media and the Forensic Imagination*, Matthew Kirschenbaum deals with the material aspects of computer culture. Published in 2008, his study focuses on one of the most important storage medium of the present: the hard drive. Grappling with authors from the field of internet research and digital media studies, such as Mark Poster, Marie-Laure Ryan, Nicholas Negroponte and Jay David Bolter, Kirschenbaum critically argues that media studies have placed their main focus on the screen, blanking out other forms of materiality. Referring to Nick Monfort, he describes this bias as "screen essentialism" (Kirschenbaum 2008: 31) and accuses media studies of pursuing some kind of de-materialisation of its research objects, and hence losing sight of what is essential when analysing media.

Critically analysing authors such as Friedrich Kittler, Katherine Hayles, Lev Manovich and Bruno Latour, he reminds us that media-materialist theory has so far only dealt with certain forms of physical materiality of digital media, such as microprocessors and circuits. Kirschenbaum argues that the media-specific, basic functions of storage have been neglected by media theory. While his critical revision of some of the positions of media materialism constitutes a vital contribution to the differentiation of this field of discourse, it also creates a number of new problems of materialist theory formation. The distinction between 'forensic materiality' and 'formal materiality' is a much-quoted key aspect of his line of argument, but also presents a certain theoretical vulnerability, which will be explained in further detail.

Kirschenbaum uses the term 'forensic materiality' to refer to the fact that the entire process of recording, distributing, processing and transmitting data is dependent on physical carrier media, such as the hard drive: "[...] computer forensics depends upon the behaviors and physical properties of various computational storage media" (ibid.: 45). The hard drive eludes the users' perception; they can only regard it as a black box (ibid.: 86). 'Formal materiality', on the other hand, is used to refer to the symbolic level of conceptual and logical objects of the human/machine interface:

> "Formal materiality thus follows as the name I give to the imposition of multiple relational computational states on a data set or digital object. Phenomenologically, the relationship between these states tends to manifest itself in terms of layers or other relative measures, though in fact each state is arbitrary and self-consistent/self-contained." (ibid.: 12)

While the perspective of 'formal materiality' is suitable for describing the constraints which the applications and the operating systems exert on the

users, the deeper layers of computer-based mediality can still only be accessed via 'forensic materiality'. On the one hand, this vocabulary allows for analyses of the interplay between hardware and software, but on the other hand, the term of media forensics emphatically used by Kirschenbaum adopts criminological discourses of searching for the truth (as applied by Bertillon and the *National Security Agency* alike) in an unreflecting and ahistorical manner, as he regards material-based forensics as an incorruptible method of making digital media culture *de facto* readable.

Digital Material/ism

While it is obviously unquestionable that there are immense differences between the media materialist approaches outlined above, we have already initially pointed out their shared motives: new materialist media theory, software studies, as well as forensic materialism highlight neglected materialities and counter common perceptions of matter. They emphasise those areas and objects which have been disregarded in (digital) media studies, hence revealing blind spots of media theory and methodological challenges. They point to the often inconvenient insight that digital media research requires research into the technological infrastructures which are less easily accessible than the representative content. Such investigations may involve tracing the materiality of media in terms of components' history, socio-economic and ecological implications, or to address the materiality of allegedly immaterial research objects such as software. All the approaches have in common that they choose 'materiality' as a starting point and core concept which allows for the investigation of media in commonly neglected manifestations and from new perspectives.

Likewise, the papers included in this issue present a wide range of research focusing on the materiality of media and media practices. At the same time, they show a mutual urge for critical, societal, political and ecological engagement. The issue is divided into five sections. The sections *Software/Code Studies and Digital Material, The Material of the Digital and Emerging Practices* and *Conceptual and Methodological Reflections* present case studies as well as discussions of theoretical challenges and methodological implications for materialist media research. The section *Entering the Field* is dedicated to the presentation of initial empirical and conceptual work. This experimental section aims to provide a platform for researchers who would like to initiate a discussion concerning their research material or methodological insights. The final section *In Conversation with* presents dialogues between the editors and authors of recently published books related to the issue's theme.

The first section focuses on software/code studies and digital material. Till A. Heilmann critically discusses and expands on Kirschenbaum's notion of 'forensic' and 'formal' materiality. Instead of seeing hardware merely as object of data inscription, he argues that digital data are also influenced by the materiality of their technological framework. Based on an analysis of the *American Standard Code for Information Interchange*, he illustrates a "reciprocal materi-

ality", describing how media materiality affects the structure of digital data. Tim Barker and Conor McKeown demonstrate the possibility of a technical media philosophy of ecology. Drawing on the philosophy of Peter Sloterdijk, in particular his concept of "air conditioning" systems, the authors show how digital technologies may act as mediators of the ecological. Their paper presents two different approaches and types of media ecology: the first part elaborates on historical cases showing how hardware has been (coincidentally) used to pick up signals from the natural world. In the second part, the authors demonstrate how the software of the eco-media videogame *Mountain* reflects an ecological structure of code systems. Their paper explores methods which enable investigations of a natural world entangled with (digital) technology.

The second part, *The Material of the Digital and Emerging Practices* comprises three papers focused on the materialities of digital technologies, and how these are experienced and employed by users. Stefan Werning highlights the shifting epistemic status of the screen. He points out how the popularisation of touchscreens has affected software features as well as the aesthetical presentation of content. Based on a case study of the *Google Material Design Language* (GMDL), he elaborates on interdependencies between touch screen technology and software features such as user interface (UI) conventions. Subsequently, he presents how (mobile) apps (e.g. *Vine* or *Tinder*) aim to convey physical 'contiguity'. His paper explores analytical tools to investigate how material and technological affordances are translated into practices and conventions of functional 'touch gestures'.

In her study "Towards an Integrated Theory of the Cyber-Urban: Digital Materiality and Networked Media at Multiple Scales", Laura Forlano explores urbanist media discourses of the present. She argues that theorists of the mediatised future city (as in big data, smart city, Internet of Things, etc.) need to devise a new hybrid vocabulary to do justice to the city as a venue of trans-medial representation.

In *Methodological and Conceptual Reflections*, Grant Bollmer, Ashley Scarlett and Yuk Hui approach theoretical and methodological issues relevant to investigations of media materiality. Grant Bollmer provides a rereading of cultural studies' history which emphasises the relevance of materiality, while likewise pointing out that this materiality and its agency have often been neglected. His paper addresses the implications of a rigid distinction between 'culture' and human agency and technological materiality. The author describes his paper as a response to the materialist turn and the rejection of the assumed humanism of cultural studies, especially embodied by the 'active audience' paradigm. He argues that an emphasis on users as active agents (and audiences) necessitates the marginalisation of technological materiality as a factor of influence in how humans embody and perform 'culture'.

Ashley Scarlett studies the conceptualisation of materiality in digital media art projects. In a first step, she contextualises selected works of art in their media-specific environments and investigates some of the key hypotheses of digital materiality. In a more in-depth approach, she then explores the media-aesthetic and media-reflexive potential of digital media art with regards to significant positions in media studies. Her paper aims at demonstrating the prospects and challenges of art practice as a form of 'digital media thought'.

Drawing on Jean-François Lyotard's notion of materialism and Gilbert Simondon's concept of concretisation, Yuk Hui develops a contemporary theory of 'relational materialism'. Instead of regarding relations as immaterial and in contrast to a substantialist view on materiality, the author argues that a relational materiality is made visible and explicit under digital conditions. The paper describes an understanding of a digital materialism which is based on relations rather than substances.

Entering the Field is an experimental section of the *Digital Culture & Society* journal. As mentioned above, this part allows for the presentation of early stage research, e.g. explorative empirical work. With this section, we aim at providing a platform for researchers to initiate a discussion concerning their research material or methodological insights.

In his paper "The Software of Philology and a Philology of Software", Moritz Hiller proposes the concept of 'software philology'. According to Hiller, software should neither be reduced to the mere syntactic dimension of alphanumerical text, nor imagined only within the logic of its execution. Instead, it is only in the intermediation of a graphic UI that an implemented source code turns active. Against this background, Hiller poses the question of how object, text, materiality and mediality of software are interrelated.

Evelyn Wan's paper, "From Her (2013) to Viv The Global Brain" deals with the question of whether and how digital media theories and network analyses can benefit from the reception of philosophical and psychological theories of experience (e.g. radical empiricism, process philosophy). In her paper, she discusses representations of human and non-human experiences in intelligent assistance technologies.

Sabrina Sauer addresses the relationships that emerge at the interface between digital objects of information and options of social interaction. Her article, "Producing and improvising (with) sensor technology", studies the 'sociomaterial configuration' of *SensorLab*, a participatory design project installed in 2010 as part of a media art festival. In close connection to science and technology studies and media sociology, she illustrates the agency and interplay between non-human and human agents.

For the final section *In Conversation with*, Annika Richterich conducted an email interview with media theorist Jussi Parikka, author of *A Geology of Media* (2015), and Karin Wenz spoke to sociologist Tim Jordan who recently published *Information Politics: Liberation and Exploitation in the Digital Society* (2015).[7]

We hope you enjoy this inaugural issue of the *Digital Culture & Society* journal.[8] Moreover, we would like to thank all authors, our editorial board members and reviewers for their cooperation and commitment. Our second issue on "Quantified Selves | Statistic Bodies" will be published in May 2016.

7 Since the conversation between Tim Jordan and Karin Wenz is based on an edited transcript, the language is more conversational than is the case in the dialogue between Jussi Parikka and Annika Richterich.

8 All articles of this issue will be published as open access 12 months after the initial publication date (cf. http://www.DigiCultS.org).

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