

# Final Report of the DOCteam Thinking Space

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Louise Beltzung Horvath<sup>1</sup>, Julia Grillmayr<sup>2</sup>, and Tanja Traxler<sup>3</sup>

<sup>1</sup>Department of Spatial Planning, TU Vienna and Department of Philosophy  
of Technology, University of Twente

<sup>2</sup>Department of Comparative Literature, University of Vienna and Department  
of Philosophy, University of Vienna

<sup>3</sup>Department of Physics, University of Vienna and Department of Philosophy,  
University of Vienna

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Part I

Project Results



# Introduction

*The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.*  
(Weiser 1991, p. 94)

*The truth is that this expansion cannot stop. The real possibilities of AmI and the advantages of its application in so many fields are what continues to push research forward. There is the need to show what can actually be done once the challenges are overcome. Once these challenges are overcome and the technology finally unravels as expected, what was once science fiction will become reality, giving the feeling of a new technological evolution.*  
(Carneiro & Novais 2014, p. 230)

The concept of Ambient Intelligence (AmI) emerged in the 1990s as a technological paradigm and still operates as a vision of a sophisticated world to come: highly-performative computer systems shall disappear into the background of the everyday and become undistinguishable from their surroundings.<sup>1</sup> Sensors, chips and internet software are to be integrated into daily things; traditional machines give way to so called smart objects, characterized as small and interconnected, automated, pro-active and predictive technologies.

The DOCTeam-project *Thinking Space* has started in October 2012 with the aim to strengthen the social sciences' and humanities' contribution to the Ambient Intelligence research area. Since then, the team has developed methodologies to approach and analyse the implications of this phenomenon from three different angles: The quantum physicist Tanja Traxler has worked on the fundamental concepts of space and relation in physics, challenging them especially with philosophical ideas of relationality. By an analysis of techno-utopian literature the literary theorist Julia Grillmayr has explored the radical change in the way in which humans address the world implied by the Ambient Intelligence paradigm. The socio-economist Louise Beltzung Horvath has worked on how space concepts may add up to a post-phenomenological analysis of disappearing technologies' social impact. The following report presents the common results of *Thinking Space* as well as the interdisciplinary set-up and the time line of the project, including the dissemination efforts.

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<sup>1</sup> See e.g. (Aarts, Harwig, & Schuurmans 2002), (Aarts & Encarnação 2006), (Aarts et al. 2008), (Bibri n.d.)

The focus of the project was to analyse the fundamental change AmI promises for the social and material environment with respect to space and relations. These technologies aim to go beyond the common interference of material world and social life. (Verbeek 2009, p. 241) Ultimately, Ambient Intelligent is about the digitization of all things and surfaces, thus, the environment itself. This imposes various risks: the unobtrusive registering of behaviour as well as the pro-active role of technologies promise a comfortable, but also highly-controlled ambience. To face these challenges, requires an understanding of the world Ambient Intelligence builds.

What kind of spaces will emerge and how relations will be mediated, are fundamental philosophical questions of political stake. The project has investigated concrete examples without losing out of sight the radical vision of an all-interconnected world of unobtrusive devices. Ambient Intelligence might not develop as fast and far reaching as foreseen, but the numerous single applications show a certain path.

The idea of walking smoothly through smart environment without boundaries, as the 1990s imagined, is still far-off. The expected pace of development for AmI has not yet been reached. Few are the moments in which people experience life or work in as foreseen within the first scenarios for Ambient Intelligence. (cf. IST Advisory Group 2001) More often than technical difficulties, questions of privacy, identity and security seem to pose problem and slow the process.(cf. Carneiro & Novais 2014, p. 226) At the same time, even though its applications are scattered, they are conceived within the ideas of an all-encompassing Ambient Intelligence world.

As common results we have chosen to focus on how space and relation have been used as main categories of research within the three different theses. This first chapter shows the importance of emphasizing the spatial dimension of Ambient Intelligence. Building on this the social impact of Ambient Intelligence as it has been addressed by the DOCTeam will be exemplified for different application domains in the second chapter. The third chapter takes a step back from the concrete realization of Ambient Intelligence technologies today, towards the implications of the radical vision driving technological development. This report is an expression of the DOCTeam spirit in the sense that it presents the commonalities across disciplines, rather than listing the complete results of the different dissertation. The work for this report forms the basis for a common publication of the team.

## Space and Relations

Throughout the history of Ambient Intelligence, space has been a key notion to understand the nature of the shift this concept envisions: “If a computer knows [...] what room it is in, it can adapt its behaviour in significant ways without requiring even a hint of artificial intelligence.” (Weiser 1991, p. 98) Mark Weiser, researcher at the Xerox Palo Alto Research Center, is one of the first to point out that the asset of future technologies does not lie in artificial intelligence only, but in context awareness and what can be called *openness*.<sup>2</sup> Until today many of those working on AmI refer to him to say that the devices’ power lies not contained in themselves but in their interaction in a defined spatial framework.<sup>3</sup> (cf. Weiser 1991, p. 100)

Despite this presence of spatial terms within the discourse for more than 25 years, and the allusion within the concept’s name, it has remained scarcely explored what changes to the understanding of space are implied. The interdisciplinary set-up *Thinking Space* has allowed to approach this question. Space has been introduced as central category to analyse Ambient Intelligence, because in this respect the newness and importance of the development comes to the fore in a physical as well as in a phenomenological perspective. Thus the project has focused on the *Ambient in Ambient Intelligence*. The underlying thesis is that if living, working and public spaces are designed to constantly interpret what happens in them and to react and act autonomously to these events, this changes our understanding of space fundamentally. This observation has led to different approaches in the respective doctoral theses and lead to the following findings:

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<sup>2</sup> The “open machine” is a term by the phenomenologist Gilbert Simondon who was one of the first philosophers to describe connectivity as a major development of technology. His considerations in *Du mode d’existence des objets techniques* from 1958 are still helpful to conceptualize this aspect of technology. (cf. Simondon 1958, 1969) Beltzung Horvath has worked on his approach to the technological object to analyse the spatial implications of Ambient Intelligence networks (Part II). In Grillmayr’s thesis this *openness* of machines is identified as basis to an ecological understanding of technology, which she develops with regard to Günter Anders and Erich Hörl. (See also Hörl 2008, p. 633)

<sup>3</sup> In how far these spatial implications hold epistemological consequences when AmI-technologies are introduced to scientific experimentation is analysed Traxler’s thesis. cf. Traxler, Tanja: *Entanglement in Space*, part III

These considerations are embedded in what has been referred to as the *spatial turn* in humanities and social sciences. Grillmayr shows in her doctoral thesis to what extent *Thinking Space* builds on this discourse, prominent mainly in literature and cultural sciences.<sup>4</sup> This regards two main arguments especially: Firstly, the understanding of space as structuring moment, rather than a mere meta category. Secondly, the insight that space has to be theorized as culturally constructed rather than a fixed container space.<sup>5</sup>

Ambient Intelligence technologies further challenge the old debate around absolute and relative space. As Beltzung Horvath shows in her thesis, thinking about their social impact requires an analysis into how they change the mediation of human-world relations. This analysis of the structural conditions of technological embeddings is linked to questions of governance, discourses and inequalities which are no universal questions but need to be contextualized and framed spatially. The gathering of data and the networked objects is not the overcoming of space as some cyberspace advocates have framed, but rather builds new spatial structures and distributions as it for instance questions the conception of private and public fundamentally. Insofar, the change in these technologically mediated relations implies always also a socio-spatial change. In a historically driven analysis Beltzung Horvath works on how the various attempts to conceptualize space, relations and objects may add up to the post-phenomenological analysis of human-technology relations.<sup>6,7</sup>

Furthermore, she explores the spatial dimension of Ambient Intelligence applications. First, this regards extending the understanding of mediation towards an opening of the object and analysing the relations it bears; this inner working of technologies that seemingly act intelligently and autonomously puts their genesis into the focus and thus, takes distance to any black-box conceptualization of technology. Second, Beltzung Horvath claims the need to distinguish between visibility, perceptiveness and the degree of presence of technologies: the paradigm of disappearing objects and systems is analysed by the means of classic phenomenology like the concepts of embodiment of Maurice Merleau-Ponty, (cf. *ibid.*, 1964), the concepts of habitus of Pierre Bourdieu (cf. *ibid.*, 1995) and the concepts of background and extension of Don Ihde (cf. *ibid.*, 1990), to show the various spatial implications Ambient Intelligence has. Third, the technological objects and systems developed for Ambient Intelligence are not all equal, neither with regard to their importance nor with regard to who will have access to them — thus, acknowledging their symbolic dimensions is important to understand their spatial significations. Fourth, the networked aspect of Ambient Intelligence technologies is put into the foreground. Because of this focus on the network, some thinkers tend to consider space not the central category.<sup>8</sup> In opposition to that, the post-phenomenological approach has emphasized the claim to shed light on the (spatial) context in which networks occur. (cf. Ihde 2010) (cf. Heidegger 1994) This analysis serves to evaluate these technologies spatial impact without limiting it to analysing single applications in practice, but also with a focus on the machinic spatial aspect of Ambient Intelligence.<sup>9</sup>

<sup>4</sup> cf. Grillmayr, Julia: *Von Menschen- und Maschinenparks*: sections 2.1 and 2.2, pp. 45–59

<sup>5</sup> cf. (Bachmann-Medick 2006, p. 292) as well as (Arias & Warf 2009)

<sup>6</sup> cf. (Verbeek 2009) and (Verbeek 2000, p. 117) as well as (Ihde 2007)

<sup>7</sup> cf. Beltzung Horvath, Louise: *Thinking Space* Part II, chapter 3

<sup>8</sup> This is the case for e.g. Bruno Latour. (cf., *ibid.* 19.02.2011)

<sup>9</sup> cf. Beltzung Horvath, Louise: *Thinking Space* Part II, chapter 4 on the ‘object centered’ approach to the analysis of spatial dimensions of AmI

*Beyond the absolute and relative dispute on space*

The dispute around absolute and relative space needs to be overcome. As Tanja Traxler shows the absolute-relative divide in space studies of physics troubles a unified conception.<sup>10</sup> The revision of the conceptual foundations of space in physics is relevant for the philosophy of physics and of crucial importance for science itself, as Albert Einstein prominently expressed (Jammer 1993 [1954], p. xiv). Re-reading the history of space concepts in the framework of transcendence and immanence allows for a complementary conception of space. In short, transcendent concepts postulate space as a super-structure to order material objects, while in immanent concepts space does not exist apart from objects but emerges through their relations. In contrast to the classical framework of absolute and relative accounts of space, the notions transcendence and immanence allow for a complementary conception of space and matter which combines elements of both. One of the lessons which fall from this is that the existence of space and matter are mutually dependent. Whereas in the classical dichotomy of absolute and relative, the space conceptions of quantum mechanics and general relativity appear exclusive, the complementary framework of transcendence and immanence brings together key aspects of both.

Ever since, conceptions of space in the social sciences have been based on physical and philosophical theories on space. (Löw 2001, p. 19) In the humanities, numerous thinkers have built their theories on the dichotomy they have seen between absolute and relative thinkers, finding a perspective that brings together key aspects of both.

In sum, the three theses have chosen different spatial approaches to analyse Ambient Intelligence. Whereas Tanja Traxler mainly focuses on the foundations of space in physics, Louise Beltzung Horvath opts for a post-phenomenological understanding of the social implications of space, which Julia Grillmayr analyses within an ecological framework. In a more figurative account, Grillmayr has worked with Peter Sloterdijk's concept of *spheres* to carve out an idea of space that is able to consider the dynamic understanding of space as well as its quality as container in the sense of the *being-contained* in an environment that can be expressed by the term *habitat*. (Sloterdijk 1998, p. 28) This theory necessarily leads to ideas and a vocabulary that originate in biology and ecology.

*Ecological thinking addresses how reactive environments imply a change in world*

Ambient Intelligence spaces can be grasped more accurately when considered as complex ecosystem, this has been one of Grillmayr's main theses. To shed light on the basic set-up of Smart Environments she firstly traces a short historical overview of philosophical ideas on *environmentality* in general and on what has been referred to as the contemporary environmental condition.<sup>11</sup> This has served Grillmayr as a starting point to think about what it means to inhabit and to be part of an (re)active

<sup>10</sup> cf. Traxler, Tanja: *Entanglement in Space*. Part I

<sup>11</sup> In this respect Grillmayr has concentrated on the philosophical notion of *world* as coined by Martin Heidegger and critically developed by Günther Anders, Hannah Arendt and Peter Sloterdijk as well as thinkers of *ecosophy*. To highlight the important role of new technology in this respect she has contrasted this tradition with contemporary philosophers of "general ecology", especially Erich Hörl who described AmI technologies as agents of a new "eco-technicity" (Hörl 2013, p. 122) and claimed to broaden ecological terms to be able to describe these technologies more accurately. (Hörl 2011, p. 10) cf. Grillmayr, Julia: *Von Menschen- und Maschinenparks*: chapter 2 "Ökologie als Denkmodell".

environment — a question that she investigates mainly in her literature analyses.<sup>12</sup>

In addition to the fact that it is common among developers of AmI to speak of e.g. “ecologies of smart agents” or “ambient ecologies”, there is an interest in “rethinking the role of intelligent systems in terms of the ecology of the home”. (Crowley & Coutaz 2015, p. 2) These images, borrowed from biology, have the advantage of expressing the complexity that necessarily arises from the various possibilities of interaction of the human and non-human agents involved. To consider the smart environment as “complex heterogeneous ecosystem with a very large space of possible services” (ibid 2015, p. 11) allows for a non-reductive and critical approach that aims at finding ways in which this large space of possibilities means freedom to humans rather than “end-users will become prisoners of closed ecosystems of smart home services subject to the dictates of the large companies”. (ibid 2015, p. 14) The ecosystemic thinking includes technological as well as social and economic aspects and thus is sensitive to the delicate balance of comfort and control that comes with AmI.

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<sup>12</sup> While the first literature analysis “Jonathan Safran Foer : Zerreiprobe des Wohnens” (chapter 4) allows for more general philosophical considerations on this topic, the second one, dealing with science fictional novels of Maurice G. Dantec “Techno-kologische Habitate” (chapter 5), addresses AmI as reactive environment directly.

## Impacts and Applications

The world is not constituted by humans versus nature, but it is a net of functions and relations, of structure, discourses, hierarchies and aggregates of stone, metal, electrics. (Bense 1998, p. 122) They are, as social practices and structures, what constitutes everyday life; our perceptions and actions are technologically mediated. Ambient Intelligence technologies, understood as mechanisms that rule the behaviour of the environment (Nakashima, Aghajan, & Augusto 2010, p. 4) have various applications ranging from the health system, to the care of elderly, security measures and scientific experimentation. In the following, we will sketch the main results for the domains that have been explored within this project.

### *The Ambient Intelligence applications of the City*

There is no way to fully understand cities without referring as well to the technologies that constitute them and those developed to reign them. (Bense 1998, p. 122) Indeed, many of Ambient Intelligence technologies target core components of the city. (cf. Böhlen & Frei 2010, p. 912) This is not surprising considering that the urban development has been from its very beginnings tight to new technologies, but also because the main element of the AmI vision is the ubiquity of interconnected applications — in other words, it is a holistic concept that goes far beyond rendering single devices *intelligent*. From the energy sector to the mobility, the health and the work sector, AmI foresees major changes that will impact not only the social, but also the built environment.<sup>13</sup>

Beltzung Horvath shows in a historical perspective how technology and its impact on city changes, from the idea that “innovations such as fax, satellite, computer networks, and Virtual Reality (VR) would actually threaten the very existence of cities” (Graham 2004, p. 4) prevalent in the 1960s and late 1990s, towards the acknowledgement that distances are never fully overcome and that cities may change but will not vanish. Her focus on the various discourses on the projected change by technologies in the urban, shows the conflicting city concepts such as the *digital city* or the *smart city*. The long-term impact of ICT and Ambient Intelligence technologies remains unclear: they may improve quality of life as well as increase social inequalities (Chourabi et al. 2012, p. 2291), which makes it important to pay close attention to the human-technology relations designed in the various domains.

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<sup>13</sup> cf. Beltzung Horvath, Louise: *Thinking Space*, part III

Therefore this thesis explores the main ideas AmI has for the city in terms of automated driving and interconnected surveillance systems.

### *Ambient Assisted Living*

Today, the healthcare sector is considered the domain that has adopted most AmI visions. This regards the provision of healthcare services at home and the support of healthcare in the hospital. In both scenarios, the main aim is to decrease healthcare costs while making it more accessible, personalized and available. (Carneiro & Novais 2014, p. 229) Applications range from more intrusive solution such as wearables to more ambient-based, non-intrusive approaches that work with e.g. cameras, microphones, pressure and floor sensors that are distributed into the environment. (Parisi & Wermter 2016, p. 3)

This brings a further shift in the role ascribed to home, as the thesis of Beltzung Horvath demonstrates.<sup>14</sup> Her historical perspective sheds light on the changes from the undifferentiated space of the home of the 18th century, to the symbol of the private and intimate space (Foucault 1972, pp. 148–149), until the smart house idea. The home becomes “a site that negotiates the need for extension with the need for emplacement, enabling secession from public life at the very same time as networked communications achieve greater levels of integration and interconnection”. (Allon 2004, p. 256) She sheds light on the non-historical parts of the discourses on changed relations such as the idea of retreat into the home as challenge to the public social life that has been prominent for other innovations as well such as the telephone (Bilton 16/03/2014, p. B7), but emphasizes the inherent risks for security and privacy that these pervasion of the private with data-gathering, but disappearing technologies might consist in.

### *Smart Labs*

Since the rise of experimental sciences, there is a co-evolution between technological progress and advances in research. The recent years have seen a number of publications where AmI technologies such as self-learning algorithms have been applied as a tool to set up and optimize physical experiments. But even though smart technologies are viewed as a promising future perspective for science among experimental physicists, there is a lack of philosophical investigation into these technological concepts in the context of physics — a gap which Tanja Traxler’s thesis aims to close. One of the lessons by doing so is that the change of conceptions in space through AmI will also be introduced into the physics laboratory — with possibly epistemological consequences for physics and philosophy.

An example for such a “smart lab” is a self-learning computer algorithm that has been developed by the Zeilinger-group at the University of Vienna in 2015. After the group had spend weeks thinking about how to design a set-up to produce a certain quantum state, the PhD-student Mario Krenn came up with the idea to write a computer program in order to solve the problem — with success: what the group was not able to accomplish within weeks, the algorithm named “Melvin” fixed just during one night of calculation. By then, the program had found a way how to arrange crucial components of a quantum-optics experiment like mirrors, beamsplitters or half-wave plates in order to produce the desired quantum state.

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<sup>14</sup> See Part III of her thesis.

The results of an experiment that have been constructed like that, have already been published (Krenn, Malik, Fickler, Lapkiewicz, & Zeilinger 2016), further experiments are projected. As Krenn stated at a discussion during the Lindau Nobel Laureate Meeting in June 2016, the next step would be that not the scientist decides what would be an interesting experiment but that the system decides by itself. At this point AmI comes into play; not only could such an experimental set-up be calculated by a computer program, but it could be created within a dynamic smart environment that basically sets up itself. Traxler explores in which ways the application of AmI technologies in the quantum lab will insofar have epistemological consequences.<sup>15</sup>

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<sup>15</sup> cf. Traxler, Tanja: *Entanglement in Space*, part III



## Visions and Futures

Ambient Intelligence is not only a highly interdisciplinary field, but bears a vision that is “far-reaching and all-encompassing in nature, and postulates a paradigmatic change in computing and society.” (Bibri n.d., p. 12) Thus, to focus only on the state-of-the-art technologies misses an essential moment of this development. Therefore, our project has also paid attention to what we call the radical vision of Ambient Intelligence: the goal to completely immerse every day practices into a technological landscape.

On first sight single applications such as fall detection systems e.g. in the care sector and lifestyle applications like smart lighting, appear to be separated systems with respective punctual functionalities, that have not much in common. However, what *Thinking Space* shows is that these applications only make sense when the Ambient Intelligence technology is considered all-encompassing in the long term.<sup>16,17</sup>

In this respect, the vision described by Mark Weiser at the very start of the AmI endeavour — his portrayal of a scattered *ambient* rather than one sophisticated machine — is still prevailing. *The Computer for the 21st Century* was not only a proposal for a smart environment-set-up, but is also a manifesto. It promotes what we refer to as radical vision: the seamless embedding of everyday practices in a technological landscape. To this effect, Weiser works with a scenario. He describes living in a smart home to point out how a technological environment like this ought to work and where its advantages lie — from automatic coffee provision to smart windows that monitor the children’s safety. (Weiser 1991, p. 102)

Indeed, it seems necessary for all approaches to Ambient Intelligence as all-encompassing technology, to tell a story. The assessment of this radical vision calls for narratives. This opens up to a questioning of what futures are described as in Beltzung Horvath’s thesis<sup>18</sup> as well to the debate for literature studies. Guided by the “empirically informed philosophy” approach of the post phenomenologist Peter-Paul

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<sup>16</sup> In her doctoral thesis Julia Grillmayr points out in how far the *Scenarios for Ambient Intelligence in 2010* published in 2001 by the European IST Advisory Group as well as the “dark Scenarios” envisioned by the project *Safeguards in a World of Ambient Intelligence* (SWAMI) support this assumption. cf. Grillmayr, Julia: *Von Menschen- und Maschinenparks*, chapter 1.3.1 “Szenarios der technologischen Umwelt”, pp. 28–32

<sup>17</sup> The importance and role of the visions for the evaluation of Ambient Intelligence technologies is explored by Louise Beltzung Horvath, who focuses as well on the scenarios of the ISTAG group and the dark scenarios. cf. Beltzung Horvath, Louise: *Thinking Space*, part I

<sup>18</sup> Beltzung Horvath, Louise: *Thinking Space*, part I

Verbeek, Julia Grillmayr undertakes “literary informed” philosophical considerations on AmI in her thesis. Literature enjoys the *privilege of fools* to envision the future in free, radical and ludicrous ways. Analysing two writers that use this precious privilege to shed light on future developments, Grillmayr carved out the main ideas, fears and hopes that their art expresses in respect to smart environment technologies.

*Extremely Loud & Incredibly Close* of Jonathan Safran Foer allows to inquire the promise of AmI to provide a more meaningful interaction with the surroundings: “Ambient Intelligence is about everyday technology that makes sense” (Aarts & Encarnação 2006, p. 1) In the novel one follows the nine year old Oskar through post-9/11-New York and discovers his most urgent need in this unstable and tensed situation: to be constantly connected to other people. For this purpose, Oskar invents various technologies that are shaped by his vivid childish imagination, but bear similarity to AmI in their core idea: an apparatus to count all the tears New Yorkers cry at night to assess the general level of sadness in the city, devices that amplify our heartbeat so that all heartbeats would synchronise, chemicals that make the skin colour change according to the mood. “Everyone could know what everyone felt, and we could be more careful with each other”, thinks Oskar. (Foer 2005, p. 163) The way in which he argues his inventions suggest that technologies such as AmI can enable people to root themselves in their surroundings and in this sense make more meaningful connections. On the other hand, this adoption of a child’s perspective can be read as an inherent critique of overenthusiastic and naive attitude towards these technologies; an attitude which is close to the idea of the “technological fix”. Because of this multi-layered approach to new technologies, the novel proves to be a fruitful starting point for a common paper on the visions of the AmI future.<sup>19</sup>

The second literary text chosen for Grillmayr’s thesis does more directly speak of new technologies: The reading of *Cosmos Incorporated* and *Grande Jonction* of the French science fiction author Maurice G. Dantec makes explicit why it is fruitful to approach Ambient Intelligence with the ideas of *general ecology*. The strong point of Dantec’s unruly, dystopic and erratic way of writing is the emphasis on the inevitable connectedness between all elements of an environment. Dantec describes the *becoming ecological* of technology and the place of the humans in this new ecology. This again corroborates our thesis that it is the radical vision of the Ambient Intelligence that has to be considered as to be able to understand the promises, the nature and the methods of the development.

For the analyses of how the fictional space and the dwelling of the literary protagonists is portrayed in these novels, the different space concepts by the DOCTeam-project have served as a basis. Besides this motif analysis, a more theoretical perspective on literature has proved to be interesting for Grillmayr’s thesis as well as for the project as a whole: Considering the smart environment as space that is soaked with information protocols and thus with text opens up another angle onto the difficult question of the relationship between the digital and the material.<sup>20</sup>

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<sup>19</sup> In the first year of the *Thinking Space* project we have published *Extremely loud and incredibly everywhere* in the course of the proceedings of the yearly Ambient Intelligence conference IsAmI, where we sketch the main lines of our approach to AmI. Cf. Beltzung Horvath, Louise; Grillmayr, Julia; Traxler, Tanja (2013): *Extremely close and incredibly everywhere*, in: Berlo, Ad; Hallenborg, Kasper; Rodríguez, Juan M. Corchado; Tapia, Dante I.; Novais, Paulo (Edts.): *Ambient Intelligence - Software and Applications*. 4th International Symposium on Ambient Intelligence. Heidelberg: Springer International Publishing.

<sup>20</sup> This image of a space charged with information protocols is of course strongly influenced by the Actor-Network-Theory (ANT) of Bruno Latour, which has been an important starting point for the theoretical framework of *Thinking Space*. (Cf. e.g. Latour 1993) While Grillmayr

Applying the ideas of Michel de Certeau of space as a practised place on to literary studies, one can state that the “*the material text is literary place, the act of reading brings into existence literary space.*” (Bushell 2016, p. 130) Place in this sense is the material of the text, e.g. the book, while space is produced by the actualization of the text through the reader and her or his cultural horizon, situation and imagination. This perspective can help to understand what it means to dwell in an constantly (re)acting environment; a text space where the mere presence and every action of a human or non-human dweller creates new protocols and thus bundles information to meaning. Considering Ambient Intelligence environments as text landscapes, the chosen novels point out that a more *meaningful interaction* with the surroundings not only means to be able to read the environment and be read by it, but also to be able to *write* the environment — to understand the underlying mechanism and algorithms of these environments and thus to play a conscious and active part in these interactions.

Thus, the conclusion of Julia Grillmayr’s doctoral thesis is entitled *Love the Machine, Hate the Factory*.<sup>21</sup> This motto of the literary movement *Steam Punk* expresses the main aspects she has found in her literature analyses regarding new technologies: the criticism of developments like AmI targets most of all the possible emphasis of unequal power structures. Both of the literature analyses do not express cultural pessimism against technology as such, but the fear of political and systemic abuse of these technologies. They show the close relatedness between social and technological practices and thus that technology cannot be understood as neutral means to an end, but as a phenomenon that fundamentally shapes our dwelling and our interactions.

These novels implicitly underline that it is necessary to find accurate ways to understand the manifold influences of these new technologies on our daily life as to develop categories of critical judgement and productive criticism, which has been a main goal to the *Thinking Space* project.<sup>22</sup>

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then focuses rather on approaches from semiotics and literary theory, Louise Beltzung Horvath dedicates part of her analysis of the technological objects on the networks they form.

<sup>21</sup> cf. Grillmayr, Julia: *Von Menschen- und Maschinenparks*, pp. 257–266

<sup>22</sup> In this respect one of the main references for Grillmayr’s considerations has been the anthology *Die technologische Bedingung* edited by Erich Hörl, especially the article of Frédéric Neyrat. (cf. Neyrat 2011, p. 150)



## Part II

# Project Management



## Interdisciplinarity

*This complexity makes interdisciplinary cooperation essential. The urban phenomenon, taken as a whole, cannot be grasped by any specialized science. [...] Once we've acknowledged or established this, the difficulties begin. How many of us are unaware of the disappointments and setbacks that resulted from so-called inter- and multidisciplinary efforts?*

(Lefèbvre 1970, p. 53)

Ambient Intelligence is the common problematic and the “boundary object” (cf. Star & Griesemer 1989) to this interdisciplinary project. The ambition to analyse how AmI transforms the relation between humans and the world was met in a multifaceted approach. We found fruitful indications of how to enable such a cooperation in the work of the French philosopher Henri Lefèbvre. He was convinced that the inquiry of what he termed the urban phenomena — all these questions of technologies, space and society — requires interdisciplinary. (Lefèbvre 1970, p. 53) Still, he remained sceptical as to how to succeed in these endeavours. Evidently, the project has shown us that to work together coming from various disciplinary backgrounds, using different methods and schools of thought, brings not only benefits, but also challenges. It has required to constantly handle the challenge of building bridges to one another’s knowledge to tackle this shared interest and topic of research. (cf. Boer, Gier, Verschuur, & Wit 2006)

On the one hand each thesis encompasses a philosophical approach that inquires into the categories at stake such as relation, world and space. On the other hand each thesis sets a further focus within its respective discipline. First, a physics approach tackles the question of how physics space concepts are challenged by these developments and call for a reformulation of philosophical foundations of physics. Second, an urban theory approach adds the focus on space to a post-phenomenological perspective as to approach these new technologies more accurately. Third, a comparative literature approach asks the question of how these technologies are foreseen to change the world-relations of humans and how this is portrayed within literature as well as within philosophical explorations.

What has proven to be a main asset to the project was the mentoring of Prof. Peter-Paul Verbeek, who agreed to supervise the project as a whole. Through discussions of the single dissertations as well as our common goals, he guaranteed a competent and encompassing supervision regarding the content of *Thinking Space*.

Furthermore, his support also structured the organization of the project in terms of deadlines and meetings.

A major issue that has accompanied the project throughout, was the different languages employed by the involved disciplines.<sup>23</sup> The project team has a strong commitment in not understanding disciplinary and theoretical-school differences as expressions of deficits, but to work within an understanding of scientific approaches as not all-encompassing, but fruitful in their co-operations. Interdisciplinarity was not only a motivation but a need, due to the strong call within the Ambient Intelligence research community that to grasp the complexity of the development no single disciplines could suffice. (Augusto, Hideyuki, & Aghajan 2010, p. 4) The tensions between the very different disciplinary understandings of space were also the driving force of this research project.

The results are no consensus on how to approach the question, rather the project shows the multiple questions raised by disappearing technologies. As Star and Griesemer (1989, p. 388) rightly point out, there is no need for a consensus for successful interdisciplinary work. Especially tackling the spatial dimensions of Ambient Intelligence, “[t]here is no point in choosing between segmentation and illumination”, because when it comes to the understanding of space, “such fragments do not constitute knowledge”. (Lefèbvre 1970, pp. 48–49)

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<sup>23</sup> An idea raised within the project proposal had been to formulate a sort of dictionary defining common terms. This has been rejected soon after, as it was more fruitful to work on the differences rather than attempting to find common meta-concepts. As all three approaches were also based on philosophy, this was not necessary.

## Coordination and Dissemination

The dissemination of the project *Thinking Space* has been accomplished by several means — some classical academic workshops, conference presentations and publications in scientific journals (see list at the end of this section) accompanied by more open strategies reaching beyond the academic domain such as publications in the web and print media as well as lecture performances (art-based research).

The project and quality management of the DOCteam consists in meetings and status reports to strengthen the interdisciplinary cooperation. Several means to accomplish this challenge have been implemented according to the proposal, some others have been added. The weekly meetings as a DOCteam have been extremely useful. Instead of using them, as the initial idea was, to define terms for the compilation of a DOCteam dictionary, we have used the time to discuss the key concepts. Also, the meetings have been occasions to help each other write, first by reading sessions and internal presentations, later by giving feedback to ideas and text sketches.

Besides the frequent discussions of the student team and the standard meetings for each PhD thesis between the respective student and each professor, meetings of the entire project team have been held including the partners and mentors abroad. In a Kick-Off-Meeting on December 17<sup>th</sup> 2012, with all the students, supervisors and the main mentor at Vienna, plans, roles and responsibilities have been communicated and discussed. In intermediary meetings between subgroups of the whole project team subtopics have been discussed and further developed.

Furthermore, the students have worked in research projects of their supervisors: Tanja Traxler has participated in Arno Böhler's FWF-projects (Austrian Science Fund) "Generating Bodies: Philosophy on Stage" (TRP12-G21) and "Artist Philosophers. Philosophy as Arts-Based Research" (AR 275-G21). In the course of the second project, she has contributed with a lecture performance to "Philosophy on Stage # 4", the main event of the project in November 2015 at Vienna. Also she has published in the special edition of the journal *Sublin/mes*, which was edited in the course of the project (see publication list). Furthermore, she will contribute an article to the final publication of the project, which is scheduled for spring 2017.

Due to the cooperation with the main mentor of the project, Peter-Paul Verbeek, philosopher of technology, it has been possible to draw together the research results of the three theses regarding AmI within a postphenomenological framework. The research exchanges at his department at the University of Twente and meetings

during international conferences and in Vienna and also regular video conferences, have involved him constantly in the course of the project.

## 6.1 Conference presentations

- 24 Traxler, Tanja (2016). *The virtual and the void in quantum physics*. Conference of the Society of European Philosophy, Regents University London, Great Britain, August 2016
- 23 Grillmayr, Julia (2016). *How to express — Jonathan Safran Foer's punctuation of too strong to express emotions*. 21. Weltkongress der International Comparative Literature Association (ICLA), Panel: Texts with No Words: Communication of Speechlessness, University of Vienna, July 2016
- 22 Grillmayr, Julia (2016). *L'apocalypse pour essayer — la littérature catastrophiste, une enseignante de l'écologie?*. 21. Weltkongress der International Comparative Literature Association (ICLA), Panel: Texts with No Words: Communication of Speechlessness, University of Vienna, July 2016
- 21 Traxler, Tanja (2016). *The virtual and the void in quantum physics*. Deleuze Studies Conference, Communication and Visual Arts of University of Roma Tre, Italy, July 2016
- 20 Grillmayr, Julia (2016). *"... which approximates I Love You" — Jonathan Safran Foer's Punctuation of unbearable Emotions*. Writing Emotions – Literature as Practice, Karl-Franzens-Universität Graz, Austria, May 2016
- 19 Grillmayr, Julia (2015). *Le réseau prend corps et disparaît — L'Internet des Objets et Martin Heidegger*. Journées du CEAQ, Université Sorbonne V, Paris, France, July 2015
- 18 Grillmayr, Julia (2015). *Was sich die Neo-Natur zurückholt*. Die Grenzen des Humanen (Workshop), Karl-Franzens-Universität Graz, Austria, January 2015
- 17 Grillmayr, Julia (2014). *Was übermorgen gewesen ist — Die Rezeption von Günther Anders im zeitgenössischen französischen Catastrophisme éclairé*. Schreiben für übermorgen, Forschungen zu Werk und Nachlass von Günther Anders, Institut für Wissenschaft und Kunst (IWK), Vienna, Austria, November 2014
- 16 Grillmayr, Julia (2014). *Jeder Blick ein Klick*. Zurück in die Zukunft – Digitale Medien und historische Buchforschung, Interdisziplinäres Symposium der Abteilung für Vergleichende Literaturwissenschaft zu Ehren von Prof. Norbert Bachleitner, Vienna, Austria, October 2014
- 15 Beltzung Horvath, Louise; Traxler, Tanja (2014): *Ambient Intelligence and the immersion of the digital into the environment*. Eye Institute Amsterdam, Netherlands, September 2014
- 14 Traxler, Tanja (2014). *The real and the possible in science*. Deleuze Studies Conference, Istanbul Technical University, Turkey, July 2014
- 13 Grillmayr, Julia (2014). *Die Welt steht auf dem Spiel*. Spielräume und Raumschiffe in der Literatur, Tagung für PromovendInnen und NachwuchswissenschaftlerInnen, Freie Universität Berlin, Germany, July 2014

- 12 Grillmayr, Julia (2014). Thinking Space. Journée d'étude Metropole Sensible: "Visions, Urbanités, Imaginaires", Université de Montpellier, France, April 2014
- 11 Grillmayr, Julia (2014). *Das unglaublich Nahe entziffern — Verräumen und Orten im Werk von Jonathan Safran Foer*. Räume räumen, Internationaler Workshop für NachwuchswissenschaftlerInnen, Universität Tübingen, Germany, July 2013
- 10 Beltzung Horvath, Louise; Grillmayr, Julia; Traxler, Tanja (2013). *Arno's Car: Postphenomenology and Ambient Intelligence*. 18<sup>th</sup> International Conference of the Society for Philosophy and Technology "Technology in the Age of Information", School of Economics and Management/Technical University of Lisbon/University of Lisbon, Portugal, July 2013
- 9 Beltzung Horvath, Louise; Grillmayr, Julia; Traxler, Tanja (2013). *Territories in-between: cyberspace and materiality*. Sixth International Deleuze Studies Conference "The Territory in between", University of Lisbon, Portugal, July 2013
- 8 Traxler, Tanja (2013). *Assemblages of sense and non-sense in quantum physics*. The First International Deleuze Studies in Asia Conference "Creative Assemblages", Tamsui University, Taipeh, May/June 2013
- 7 Beltzung Horvath, Louise; Grillmayr, Julia; Traxler, Tanja (2013). *Extremely Small and Incredibly Everywhere*. 4<sup>th</sup> International Symposium on Ambient Intelligence, University of Salamanca, Salamanca/Spain, May 2013
- 6 Grillmayr, Julia (2012). *L'enveloppementalisme technologique*, Journées du CEAQ 2012, Paris, June 2012
- 5 Beltzung Horvath, Louise; Grillmayr, Julia; Traxler, Tanja (2013). *Thinking Space*. DOC-team-Graduierten Konferenz, Österreichische Akademie der Wissenschaften, Wien, February 2013
- 4 Beltzung Horvath, Louise; Grillmayr, Julia; Traxler, Tanja (2013). *The Materialization of the Virtual*. Konferenz 'Mattering: Feminism, Science and Materialism'. City University of New York, February 2013
- 3 Grillmayr, Julia (2012). *Rhizome, keine Wurzeln*. Graduiertenkonferenz der Abteilung für Vergleichende Literaturwissenschaft der Universität Wien, Austria, November 2012
- 2 Traxler, Tanja (2012). *Becoming in quantum physics*. International Ontology Congress PHYSIS — From elementary particle to human nature, Departamento de Filosofía, Universidad del País Vasco San Sebastian, October 2012
- 1 Beltzung Horvath, Louise; Grillmayr, Julia; Traxler, Tanja (2012). *Thinking Space. An interdisciplinary approach to the spatial dimensions of Ambient Intelligence*. Symmetries and asymmetries in the interaction between humans and objects. Konferenz "Kritische Theorieperspektiven auf Technik", TU Hamburg-Harburg, March 2012

## 6.2 Publications in scientific journals and books:

- IX Grillmayr, Julia (2016). *Das Spielfeld, der Einsatz, das Ziel, Die Welt — das lebensgroße Spiel in Jonathan Safran Foers Extremely Loud & Incredibly Close*, in: Dettke, Julia; Heyne, Elisabeth (Eds.): *Spielräume & Raumspele in der Literatur*, Verlag Königshausen & Neumann, Würzburg
- VIII Grillmayr, Julia (2016). *Jeder Blick ein Klick — Digitale Literatur als Indikator der technologischen Umwelt*, in: Danielczyk, Julia; Hall, Murray G.; Hermann, Christine; Vlasta, Sandra (Eds.): *Zurück in die Zukunft — Digitale Medien, historische Buchforschung und andere komparatistische Felder*, Harrassowitz, Wiesbaden
- VII Grillmayr, Julia (2016). *La rue comme Monde ou Désert*, Les Cahiers Européens de l'Imaginaire, No 8, CNRS, Paris
- VI Beltzung Horvath, Louise; Maicher, Markus (2016): *Rethinking the City as a Body without Organs*, in: Frichot, Hélène; Gabrielsson, Catharina; Metzger, Jonathan (Eds.): *Deleuze and the City*, Deleuze Connection series: Edinburgh University Press.
- V Traxler, Tanja (2015). *Now tell me, how do you take atomism?*, in: Sublin/mes – Philosophieren von unten, Heft No 5, Wien
- IV Traxler, Tanja (2014). *The rhythm of the void*, in: Sublin/mes – Philosophieren von unten, Heft No 4, Wien
- III Beltzung Horvath, Louise; Grillmayr, Julia; Traxler, Tanja (2013): *Extremely close and incredibly everywhere*, in: Berlo, Ad; Hallenborg, Kasper; Rodríguez, Juan M. Corchado; Tapia, Dante I.; Novais, Paulo (Eds.): *Ambient Intelligence — Software and Applications*. 4th International Symposium on Ambient Intelligence. Heidelberg: Springer International Publishing.
- II Grillmayr, Julia (2013). *On ne parle pas la bouche pleine — L'appétit et les langues du corps sans organes*, Les Cahiers Européens de l'Imaginaire, No 5, CNRS, Paris
- I Traxler, Tanja (2013). *Realtime-Gendering und queeres Physizieren*, in: Sublin/mes — Philosophieren von unten, Heft No 2, Wien

## Time Line

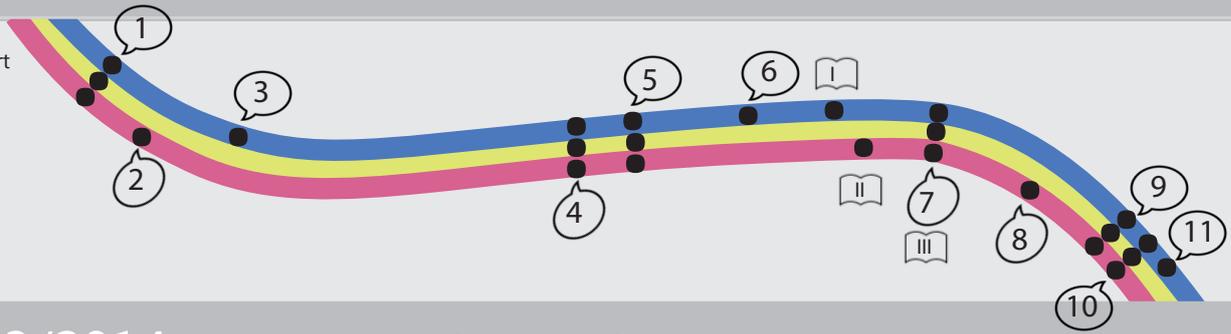
The core of the DOCTeam project organization has been to find a way of collaboration that ranges from internal group meetings to common publications and conference participations. In the following figure we illustrate the activities from the project start until today.

Originally, this project has been set up within a time frame of three years from October 2012 to 2015. In the meantime there have been a range of modifications made to the course and duration of the project. This is related to additional funding acquired in varying intensity by the participants for research exchanges abroad (Marietta-Blau grant) as well as to interruptions due to parental and educational leave. What has remained throughout the project — including the breaks — was an intense exchange between the students involved, which has ranged from cross-reading parts of the dissertations to discussing theoretical and methodological approaches.

The **first year (2012/2013)** has opened with a workshop of the whole DOCTeam including the mentors. The focus in this first period lied on working on the common topic and included several workshop and conference presentations within the respective disciplines but also within the technologically-dominated field of Ambient Intelligence research. In the **second year (2013/2014)** the students built upon these findings and premises to develop their methods and approaches for their respective doctoral theses. The focus of the DOCTeam in this period clearly laid on establishing the basis of the single dissertations and starting the writing process; the meetings especially served as reading, writing and discussion circles. In the **third year (2015/2016)** the DOCTeam project was on hold for several months: Tanja Traxler took a educational leave from January 2015 to February 2016 on. Louise Beltzung Horvath is on a parental leave since December 2015. Still, the students have continued to meet and collaborate on smaller projects. One major step for the whole DOCTeam was the end of the thesis of Julia Grillmayr who handed in her thesis at the University of Vienna in July 2016. **This year (2016/2017)** will be the last year for all the DOCTeam members. Julia Grillmayr plans on defending her thesis in November 2016. Louise Beltzung Horvath has a parental leave until February 2017 and is funded until October 2017 — she plans to have finished her thesis including the *defensio* until then. This time frame will be also the goal of Tanja Traxler. As planned, there will be a common publication on the results of the project, a paper within a peer-reviewed journal together with *Thinking Space* main mentor Peter-Paul Verbeek.

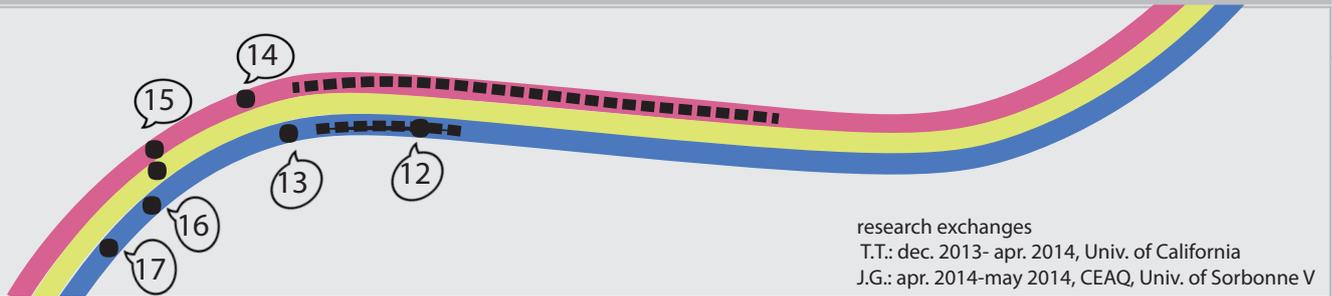
# 2012/2013

october  
project start



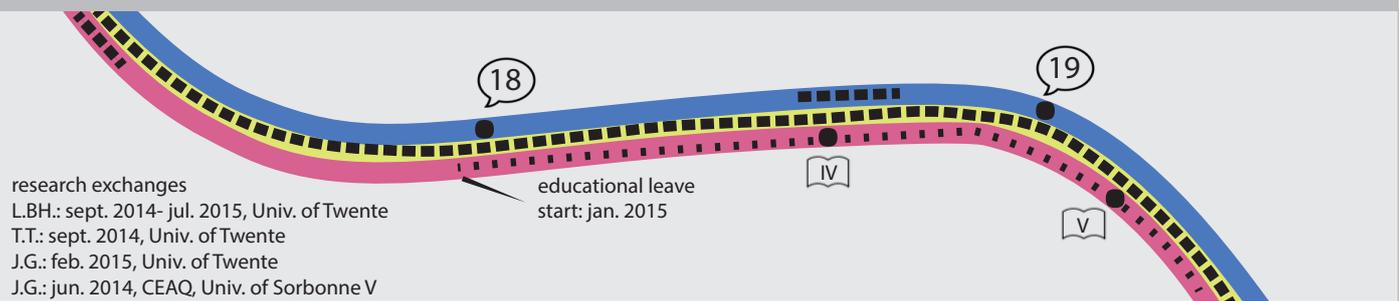
# 2013/2014

october '13 - september '14



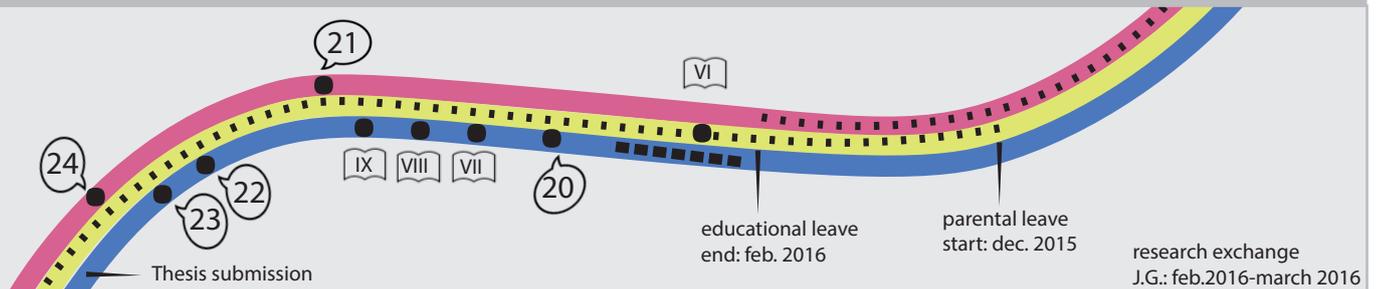
# 2014/2015

october '14 - september '15



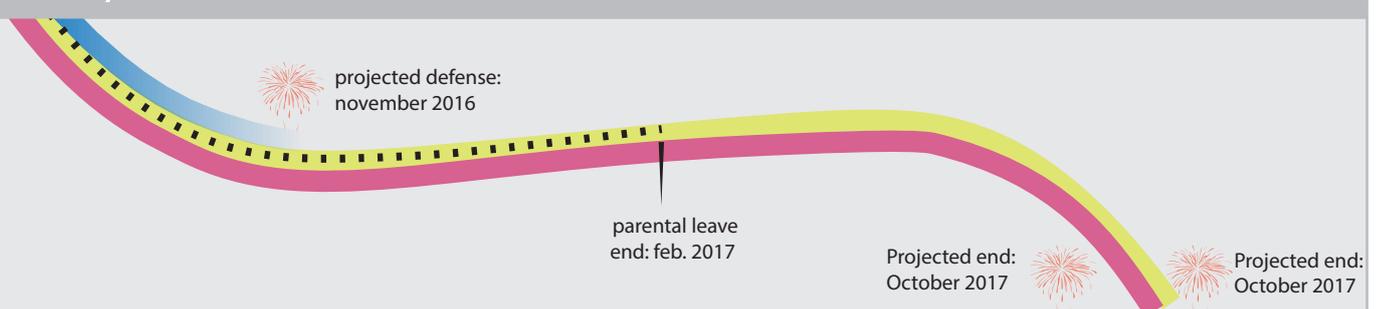
# 2015/2016

october '15 - september '16



# 2016/2017

october '16 - september '17



Tanja Traxler  
Louise Beltzung Horvath  
Julia Grillmayr

Research exchanges  
Educational and parental leave

Publication  
Conference presentation

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