



Research Training Group

Fixing Futures: Technologies of Anticipation in Contemporary Societies

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2. Research Programme

2.1 Objectives and Work Programme

2.1.1 Outline of the Research Programme

Modernity was long defined by the narratives of technological optimism and scientific progress (Heilbroner 1967; Bell and Mau 1971; Brown et al. 2000) in which the future appeared as the overall promising horizon of modern societies (Urry 2016). Indeed, the history of the modern future (Koselleck 1988) is saturated with utopian concepts and scientific visions associated with such iconic innovations as railway lines, skyscrapers, vaccines, satellites, power grids, and the internet (Rosenberg and Harding 2009).

Today, political, economic, and ecological uncertainties seem to have absorbed most remaining “utopian energies” (Graf 2021). The long-standing belief that we are moving relentlessly towards the future seems to have turned into its opposite. It appears that the future is moving towards us — and more often than not, this future is perceived as threatening rather than promising. Phenomena such as global warming, biodiversity loss, and global pandemics have a profound impact on how we orient ourselves towards the future, including the prospect of not having a future at all (Betz and Bosancic 2021). Instead of fulfilling the modern promises of emancipation and freedom, future perspectives today often focus on blockages, hazards, and tipping points.

Against this backdrop, a growing body of work has emerged in the past two decades in STS and beyond that argues for the need to explore how different futures are enacted through socio-material assemblages. Within this research, the **concept of anticipation** plays a crucial role (Brown et al. 2000; Brown 2003; Brown and Michaels 2003; Sturken et al. 2004; Borup et al. 2006; Anderson 2010; Beckert 2013; Poli 2017; Alvial-Palavicino and Konrad 2019; Davis and Grove 2019; Konrad and Böhle 2019). Derived from the Latin “anticipare” (literally: taking care of something ahead of time), anticipation defines a mode of future-making that authorises actions in the here and now in the name of the future. The relevant research literature conceives of anticipatory temporalities as **characteristic of “life in contemporary liberal democracies”** (Anderson 2010: 792; Granjou et al. 2017: 8). To be sure, anticipatory orientations have long been an important component of political and economic processes, seeking to avert dangers or to realise hopes. However, these practices seem to have been extended and intensified in the present. The increasing significance of “anticipatory action” (Anderson 2010: 778) results from serious threats to liberal-democratic societies that have become visible since the turn of the millennium, such as post-9/11 terrorism, the risk of pandemics, ecological disaster, and other “collective existential challenges” (Anderson 2010; Scheffer and Schmidt 2019). Moreover, transformations in contemporary capitalism such as the increasing importance of finance capital, the rise of neoliberalism and the “entrepreneurial self” (Bröckling 2015) have significantly contributed to the contemporary impulse to anticipate future events and developments.

Compared to other modes of responding to the future, anticipation is defined by a distinctive temporal and practical orientation. It differs from practices of **speculation** (Cortiel et al. 2020) as it focuses on the future as “actionable” (Anderson 2010: 794). Anticipation is a practice that goes beyond imagining or narrating the future in order to authorise what could or should be done in the present. Rather, it conceives of the future as both fundamentally open and inevitable and demands actions in the here and now to change the course of events. Anticipation also has to be distinguished from the logics of **prevention**. Anticipatory practices are characterised by a distinctive realism as they prepare for the event “as if it were already here, rather than offering ‘prevention of’ it so that it never happens” (Adams et al. 2009: 258). Finally, anticipatory practices go beyond the analytics of **risk**. While the diagnosis of the “rise of a multitude of specific forms of anticipating and assessing the future” (Alvial-Palavicino and

Konrad 2019: 193) shares some elements with the risk society thesis (Beck 1992), e.g. the increasing recognition of the proliferation of catastrophic and uninsurable risks, there is an essential difference. Instead of putting forward the idea that (Western) societies rely on the management of calculable risk, anticipation is a practice that transforms indeterminacy and contingency into practical challenges. Interventions justified by perceived threats that may or may not come therefore differ from modern types of governing so-called risk societies (Diprose et al. 2008; Alvial-Palavicino 2015; Groth 2021).

To the present day, “anticipation” has been addressed in two different ways in scholarly literature. Some authors take anticipation as a generic term to describe **the general future-orientedness of contemporary societies**, identifying a “regime of anticipation” (Adams et al. 2009; Mackenzie 2013; see also Dolez et al. 2019). Understood as a societal future-orientedness, anticipation relies on logics that justify measures and interventions without claiming proof that they will effectively avert the threats posed. In this understanding, distinct “logics of anticipation” (Anderson 2010) can be highlighted: e.g. precaution, preemption, and preparedness. Precaution sets in “once a determinate threat has been identified”, meaning it acts “before the identified threat reaches a point of irreversibility” since “[t]he presumption is that delay may be far more costly to that life, even if absolute proof of impacts and effects is lacking” (Anderson 2010: 788-89; see also Ewald 2002). The logic of preemption, in comparison, implies taking active steps towards intercepting and averting threats (Cooper 2006). Finally, the invocation of preparedness and its implementation via policies and plans lays out what to do when the feared event has occurred. Instead of stopping the course of events, preparedness thus intends to limit their destructive and disruptive consequences (Anderson 2010; Lakoff and Collier 2010).

Conversely, other scholars have introduced anticipation as a **specific mode of futurity which particularly hinges on contingency and complexity** and ultimately on the impossibility of controlling future developments (Alvial-Palavicino 2015). In this understanding, anticipation sits somewhat uneasily between attempts to predict, know, and control the future on the one hand and acknowledging the impossibility of doing so on the other. It depends on socio-material assemblages that establish a relationship between our actions and the future by drawing “present and future into the same activity timespace” (Bryant and Knight 2019: 22). A focus on anticipation as a contingent, highly dynamic imaginary of the future also makes it possible to account for alternative ways of acting upon the future, as have been foregrounded by feminist and postcolonial scholars (Grosz 2002; Puig de la Bellacasa 2015; Chakkalakal 2018). Instead of following the predominant temporal orientation of technoscientific intervention as an inherently “progressivist”, “productionist” and “restless mode of futurity” (Puig de la Bellacasa 2015: 694), this approach pays attention to the many ways people engage with specific devices, tools, and policies to fix the future despite its uncertainty (Haraway 2016; Waltorp 2017; Ballesterio 2019).

This understanding of anticipation therefore also has parallels to the rich debate on expectations in STS and sociology. Sociologies of expectation have explored how future-oriented imaginings and visions direct and shape scientific and technological activities by mobilising material and immaterial resources, coordinating heterogeneous groups of actors, and defining risks and opportunities (Brown 2003; Brown and Michael 2003; Borup et al. 2006; Tutton 2011; 2017; van Lente 2012). Building on but departing from this, the focus on anticipation examines how expectations of the future are created and tested explicitly (e.g. calculations, modelling, forecasting etc.) or implicitly by anticipatory practices as they put forward particular assumptions about the future (Alvial-Palavicino and Konrad 2019: 193-4).

Anticipation, here, is a situational, affectively loaded, and contingent practice that relies to a lesser extent than expectation on past experiences (Groth 2021).

The RTG seeks to empirically extend and conceptually advance these partially conflicting and partially intersecting perspectives by focusing on **“technologies of anticipation” as a larger frame through which to explore the plurality and diversity of contemporary practices of making futures**. We propose the concept “technologies of anticipation” to enhance the existing debate by accentuating the materiality of anticipation – instead of focusing primarily on imaginations, narratives, and speculations. By “technologies” we mean regulated and coherent sets of practices that enact distinctive practical and goal-oriented rationalities and differ from ad hoc doings and singular actions. Technologies of anticipation go beyond the analytic focus on isolated techniques or singular modes of anticipation and are to be understood as a larger set of practices that seek to calculate and manage probabilities and aleatory developments. By focusing on technologies, our research will therefore target the practical enactments of anticipation and the material infrastructures and networks upon which they rely, rather than examining a distinctive “logic” (Anderson 2010; Alvial-Palavicino 2015) or rationality of anticipation.

Our guiding assumption is that in contemporary societies **anticipation is becoming more and more bound up with concrete technoscientific practices** that allow for the pursuit of some futures and “world-orders” (Andersson and Kemp 2021: 4), while others are suspended or even foreclosed. The RTG starts from the observation that technologies of anticipation refer to socio-material assemblages that co-emerged with the rise of neoliberalism, and which have undergone profound reconfigurations, for example through post-9/11 security practices, old and new environmental crises or novel techno-scientific possibilities of reworking, capitalising, and governing life and death. They seek to provide solutions to a range of societal and political problems from pre-empting collective threats such as ecological disasters to preparing for individual risks such as loss of fertility. They are therefore said to offer “technological fixes” (Volti 2014) or forms of “solutionism” (Morozov 2013; see also Katzenbach 2021). While it is easy to reject or dismiss such a disposition, it raises the critical question of how exactly fixing practices relate to the future. Taking this question as a point of departure, the research training group will empirically examine how technologies of anticipation work in a diverse set of fields. More specifically, we aim to **investigate the interplay of two distinctive dimensions of anticipatory practices that engage in fixing futures: “stabilisation” and “repair”**.

The **first sense of “fixing”** is associated with attempts to control the future through **stabilisation**. Strategies of stabilisation can be informed by an economic rationality that addresses various crises of capitalist accumulation by extending itself, both in space and in time (Harvey 2001). A different set of strategies relies on rationalities of resilience, prediction, and preparedness to protect “vital systems security”—that is, material circuits of circulation that provide functions and services deemed to be indispensable for life in contemporary societies (Collier and Lakoff 2010; 2015; Kelty 2011; see also Walker and Cooper 2011). More broadly beyond that, “securitisation” (Aradau and van Munster 2007) can be seen as a general tendency which aims to stabilise the status quo in fields of governance as different as international migration and global health policy.

While strategies of stabilisation might take particular forms and rely on very distinctive rationalities, they always seek to render invisible or improbable divergent future trajectories. Stabilisation as an attempt at fixing therefore also implies specific ways of enacting futures by marginalising, excluding, or even erasing alternative pathways. Thus, in an important sense, stabilising refers to both practices of doing and undoing futures. It privileges particular needs, visions, and lifestyles that appear rational, natural, or self-evident and therefore as difficult to

change or even beyond conscious decision-making. While ‘we’ seek to fix the future, the future also fixes ‘us’, and this observation stresses the ambivalence captured in the title of the research training group.

The **second sense of “fixing”** complements the first. **Repair** (Strebel et al. 2019; Denis et al. 2015; Graham and Thrift 2007) is concerned with particular problems or threats that need to be urgently addressed, often in an experimental manner which makes these strategies a permanent process of “failing forward”—the successive circle of experimenting, (partly) failing, and setting up new experiments (Peck and Theodore 2019). In various repair practices, the future figures less as an extension of the present than as a state where the effects of certain accidents, disasters or other unwanted events and processes have to be remedied (Tironi et al. 2014; Lorimer 2017). In the context of climate crisis and what has come to be known as the Anthropocene, this sense of fixing is also discussed together with the assignment of responsibility (Stengers 2015; Tsing et al. 2017; McLaren 2018), the development of alternative imaginaries for the future (Roelvink et al. 2015; Haraway 2016; Andersson 2018), and questions of legitimacy (Kuch 2017). Furthermore, repair practices might be linked to a relational logic of care (Mol 2008; Puig de la Bellacasa 2015) that begins by affirming rather than negating dependencies and vulnerabilities, seeking to affirm instead of erasing them.

As with stabilisation, it is important to attend to the selectivity of repair practices, for which the process of problematisation plays a crucial role. To initiate a repair strategy, a problem or possible threat has to be identified by framing it as such; defining what is included and excluded; gathering, or better “producing”, knowledge on it (Flyverborn and Garsten 2021), in order to finally develop a general picture of how - by which socio-material means - it can be addressed. In other words, in the very same moment when problems are rendered visible and become subject of contemporary fixing strategies, other problems, or other possible ways to see and address the same problems, are obscured.

By fixing futures, **technologies of anticipation promote a normative grammar that values foresight and preparedness**. They instigate a “moral responsibility of citizens to secure their ‘best possible futures’” (Adams et al. 2009: 246) and significantly shape daily life and contemporary regimes of subjectivation (Granjou et al. 2017: 8). These technologies are intimately linked to “affective economies” (Ahmed 2004) that are not limited to the hopes and fears of individual subjects but also mobilise the emotions and desires of collective subjects (Adams et al. 2009: 249; see also Groves 2017: 29). However, technologies of anticipation unevenly and unequally distribute political capacities, moral responsibilities, and material resources. Feminist researchers in STS have shown that **anticipatory practices are often “distinctively gendered”** (Adams et al. 2009: 253). One example is the proliferation of reproductive technologies, which co-produces new modes and fields of responsibility from managing fertility (Waldby 2019; van de Wiel 2020) to controlling conception (Franklin and Robertson 2006) and foetal health (Casper 1998; Sänger 2020). Technologies of anticipation range from political strategies promoting “girlhood” in the Global South as a particularly promising investment in human capital that also results in lower future fertility (Murphy 2017) to the medical control of genetic risks for cancer and beyond (Hallowell 1999). Moreover, **interventions to forestall and/or enable distinctive futures are also frequently racialised**. The anticipation of apocalyptic scenarios is frequently imbued with “fears of racialised others” (Gergan et al. 2020) in which the open-ended futurity and the anticipatory capacities of the *white* liberal subject are intimately connected to “the repetitive and durable temporalities of black and indigenous subjects” (Grove et al. 2021: 629; see also Murphy 2017). The possibility for some of an open future and of acting on the “not yet” seems to be based on a “stalled present” (Scott 2014: 6) for others.

While a number of scholars working on anticipation have either concentrated on its knowledge dimension or stressed its performative aspects, the RTG seeks to extend the scope of STS research in this field. While acknowledging the importance of analysing forms of knowledge and the performative effects of anticipatory practices, we are convinced that it is necessary to investigate the conflictual and contested material effects that anticipatory practices often have. The RTG neither subscribes to an understanding of anticipation as either a comprehensive and coherent “regime” (Mackenzie 2013: 391) or “hegemonic formation” (Adams et al. 2009: 248), nor as that which stresses the management of a dynamic, indeterminate, and radically open future. Rather, it seeks to analyse how technologies of anticipation narrow down contingencies and fix futures through strategies of stabilisation and repair – while always remaining open to contestation and conflict. Understanding anticipation this way necessarily raises that which is unanticipated and thus the potential making of alternative futures. Thus, **the RTG attends to the power asymmetries and operational tensions involved in the enactment of anticipatory practices to inquire which forms of life are to be protected, enhanced, or saved (and which are excluded, marginalised, or destroyed)** (Anderson 2010; Collier and Lakoff 2015). Such a take also demonstrates the need to explore and understand what kinds of expertise and knowledge are valued in fixing practices, and who controls the capacities to shape the future within the present, prevailing over the “means of anticipation” (Aykut et al. 2019: 4; see also Groves 2017). Which issues become “matters of concern” (Latour 2004) or “matters of care” (Puig de la Bellacasa 2017) to be addressed in anticipatory practices, and who has the power to define them? What normative values materialize in these technologies and how do they enact and restabilise certain forms of life at the expense of others? So far, the ambivalent dynamics of future-making and “future-taking” (Adam 2021) remain empirically underexplored.

Beyond articulating their material and contested dimension, **the concept of technologies of anticipation** also enriches ongoing debates in STS in two more ways. First, it goes beyond the exclusive focus on either an “urgency of disaster” (Collier and Lakoff 2021: xi) or the normality of “daily life” (Granjou et al. 2017: 8), **offering a more comprehensive term to address the exceptional and the mundane within a singular analytical frame.** It not only provides a conceptual bridge to study the interplay between individual and collective subjectivities but also explores how “everyday life” might be connected to “slow emergencies” (Grove et al. 2021), opening up the question of the conditions under which an issue becomes an “emergency” to be fixed by technologies of anticipation. Secondly, the concept also **acknowledges the material power of non-humans in shaping futures.** Technologies of anticipation go beyond conscious intention or active reflexivity to include “the capacity of an organised system to incorporate projected futures states into its present functioning as a way of orienting or modulating its activity” (Groves 2017: 30) – a capacity that beyond humans also pertains to complex machines, material infrastructures and ecosystems. As technological systems as well as animals, plants, geological and physical forces can “instigate change and trigger the advent of unprecedented and partly unpredictable futures” (Granjou et al. 2017: 7), we need to recognise the “anticipatory assemblages” (Alvial-Palavicino 2015: 158-162; Groves 2017: 33) and the “shared futurities of nature-culture entanglements” (Granjou et al. 2017: 7; see also Haraway 2016) that transgress the still dominant human-centred account of anticipatory practices in STS and beyond.

2.1.2. Three Research Fields

The RTG will explore technologies of anticipation in three research areas: economic practices, modes of government, and processes of life. The choice of the different empirical fields is based on the assumption that they cover essential dimensions of the shifts described above, which lead to the emergence of novel socio-material assemblages. While the research fields relate to distinct empirical spheres, they also intersect and overlap in many ways. In all three fields, strategies of stabilisation and repairing exist in parallel and in close interplay. Investigating their dynamics in concrete domains of future-making lies at the core of the RTG. **Bringing out the material and contested dimension of technologies of anticipation in the process of fixing futures**, the RTG responds to a crucial need recently identified in research on anticipation (see, for example, Adam 2021). It develops a conceptual toolkit that allows us to better understand how the future is enacted as material and narrative as well as, simultaneously, process and product. Moreover, in empirically exploring how making futures goes hand in hand with taking futures, the RTG situates research on technologies of anticipation within postcolonial and feminist technoscience, scrutinising how these technologies contribute to the production and reproduction of power relations – but also whether and how they allow envisioning alternative futures (Haraway 1991; Verran 2001; Rottenburg 2009; Murphy 2017; Khandekar et al. 2017).

2.1.2.1. *Research Field 1: Economies*

The first research field of *Fixing Futures* deals with economies and conceives of them as socio-material configurations that cope with uncertainty. Economic decisions are always confronted with the condition of unknown futures; they have to rely on technologies of anticipation and employ “fictional expectations” as present imaginaries of future situations (Beckert 2016). Moreover, capitalist economies operate through a logic of permanent expansion that incessantly needs to find new promissory fields of investment and speculation. The omnipresence of uncertainty in economic processes introduces instability and fragility, and the challenge of how to preserve social attachment to the general model of economic development as well as to concrete strategies and projects.

This inherent tension in modern economies necessitates developing and adopting mechanisms of **stabilisation**. As studies in STS have shown, a fundamental force in fixing economies is the discipline of economics. The integration of the models and vocabulary of physics into economic discourse at the end of the 19th century made it possible to translate the instability of economic processes into the already well-established language, imagery, mathematical style, and explanatory reasoning of physics (Mirowski 1989). This laid the ground for the invention of the (national) economy as a measurable, shapeable, and controllable territorial unit in the early 20th century (Mitchell 1998, 2008; Murphy 2017). As such, it became increasingly the target of economic interventions, a “laboratorisation”, as Callon et al. (2009) have termed it.

As research in social studies of marketisation and economisation (Callon 1998; Callon et al. 2007; MacKenzie et al. 2007) shows, markets are situated arrangements of heterogeneous elements which recursively inform and intervene in processes of marketisation (Berndt and Boeckler 2009; 2011; 2012; Ouma, Boeckler and Lindner 2013; Lindner 2018). These market (re-)arrangements install ever new technologies of forecasting and (algorithmic) prediction, devices of exchange and valuation, and practices of preparedness and precaution (Collier and Lakoff 2008; Oels 2013). They also inaugurate infrastructures of circulation which stabilise future trajectories (Boeckler and Sternmanns 2018) and perpetuate the current condition of supply chain capitalism (Tsing 2009), which requires a continuously reliable future present.

One important example that illustrates how temporary stabilisations are constantly being challenged is digitisation (Boeckler 2014). Algorithms, machine learning, and big data are currently reconfiguring labour, markets, governments, privacy, professional skills, social identities, and moral norms in unpredictable ways (see Eubanks 2018). In the past, individual economic activities were structured around tedious calculations of costs and benefits in view of expected future returns (Mennicken and Miller 2012), but now powerful (self-learning) algorithms automate the “account-ability” of economic life (Neyland 2019) and regulate the space-time peculiarities of future demand (Richardson 2020). Platforms are challenging existing regulatory frameworks for business and offer algorithmic efficiency in on-demand markets that render regular employment into a series of singularised gigs (Rosenblat 2018). This novel figuration of “platform capitalism” (Langley and Leyshon 2017; Srnicek 2017; Mackenzie 2018) not only relies on interventions in imagined futures but is also infrastructurally stabilised in non-territorial spatial formations (Bratton 2016). Cloud-storage, protocols, and interfaces have become the architectural foundation of captivating devices designed to attach users to platforms in order to generate network effects that can be capitalised.

The stabilisation of market processes depends crucially on the successful creation of attachment as an objective and affective experience of goods and services – “markets proliferate attachments and attachments proliferate in markets” (McFall et al. 2017: 2). Yet at the same time, attachments have to be dissolved to make exchange between atomised individuals possible. For instance, on the global surrogacy market the accumulation of value depends on the affective fixing of bodies to bodies as well as on the effective detachment of bodies from bodies (Pande 2014; Schurr and Militz 2018). Yet even in more mundane markets, it is the interplay of aesthetic, corporeal, and emotional fixings that create future interdependencies through which the heterogeneous components of market arrangements are stabilised (McFall et al. 2017). The results are “affective economies” (Ahmed 2004), where emotions circulate along the sticky contact zone of bodies, objects, and signs.

Despite continuous efforts to stabilise the economy, market failure is by no means accidental or exceptional but deeply engrained in the working of capitalist accumulation, as David Harvey (2001) and many others have shown. Still, in spite of repeated breakdowns of sectoral markets and the persistence of crises, markets remain the predominant technology for tackling the always uncertain future of economies and, paradoxically, market solutions are deployed to **repair** the (anticipated) negative effects of the market principle. They express the economy’s capacity to regulate itself precisely *through* recurrent crises and countering the unintended consequences of markets with ever new rounds of marketisation. Examples of this include carbon markets fixing carbon modernities (Paladino and Fiske 2017), weather insurance markets addressing climate change (Johnson 2013; Collier 2014), and ecosystem service approaches confronting ecological degradation (Braun 2015; Castree and Christophers 2015).

The implementation of neoliberal economic policies in the last few decades in many countries around the world has been characterised by the dismantling of social security mechanisms and the delegation of collective responsibilities of the (welfare) state into the hands of the market. To ‘repair’ the resulting problems of poverty and the lack of social protection, “social finance” emerged (Langley 2018) as a novel figuration of “bonded life” (Kish and Leroy 2015) and “caring capitalism” (Barman 2016). In this vein, global health has been turned into a speculative financial device with “catastrophe bonds” as the key vehicle for future profit (Erikson 2019). While financialisation has always been a material practice that translates anticipated future earnings into present valuations (MacKenzie 2009), social finance has brought about a novel metrological profession that skilfully attempts to measure the future social impact of current financial investments (Mitchell 2017, Barman 2015, Chiapello 2015).

Over the last decade another repair strategy which blames not markets but the not-so-rational subject for failures has become influential (Thaler and Sunstein 2008). Here, technologies of anticipation take shape which aim to correct human behaviour by designed choice architectures and so-called behavioural nudges (Boeckler and Berndt 2013; Berndt and Boeckler 2016; Lindner 2020). This “roll-in neoliberalism” (Berndt and Boeckler 2017) creates particular links between individual preferences and the options open for choice.

Where unintended effects brought about by the working of the market principle are identified and need to be repaired, interference in existing market configurations often goes hand in hand with a reordering of modes of attachment and detachment. This becomes most strikingly clear where the relationship between society, nature, and economy is at stake. In this context, attachment as a “liability”, an “obligation from the past that is brought to bear on the present” (Hennion 2017: 112), is increasingly related to nothing less but the earth we inhabit, which is threatened by the current economic mode of production and consumption. Our “life in capitalist ruins” (Tsing 2015) calls for the design of more-than-human economies (Barua 2019a, b) and for radically alternative economic futures to repair the increasingly obvious consequences of current trajectories. Struggles for post-capitalist economies; no-growth approaches; the multifarious spectre of sharing and community economies; and recent discussions about expropriations all bear the ambivalent quality of being both strands of critique to repair the future shape of concrete markets and counter-movements for future economies beyond the market (Roelvink et al. 2015).

2.1.2.2. Research Field 2: Governance

The idea of the future being an object open to interventions not only structures economic practices but also informs modes of contemporary government. As a field, governance offers research opportunities to investigate how expert as well as lay knowledges (Hänel et al. 2021), together with technologies and techniques, are implicated in anticipation (Groves 2017). It is also concerned with the question of how expectations derive from these socio-material practices (Alvial-Palavicino 2015) and how “sociotechnical imaginaries” (Jasanoff and Kim 2015) are “animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology” (ibid.: 4). Furthermore, future-making in public policy and governance is not merely confined to imagining possible, desirable, and competing futures and to implementing policies to that effect; it has a technical, infrastructural, and indeed necessarily material dimension that makes it particularly important for science and technology studies-inspired approaches (Barry 2001; 2013; Marres and Lezaun 2011; Asdal 2014). Anticipatory practices include standards and testing, taxing and budgeting, surveillance and monitoring. Future-related political decision-making, policy development and implementation, as well as planning, are all especially pertinent in regard to infrastructures (Anand et al. 2018). Traffic and public transport systems, policing, public health, and education rely heavily on forecasting and prediction. Predictive knowledge production through calculative techniques and modelling is being revolutionised by digital technologies that allow new forms of surveillance and the processing of large quantities of data enhanced by algorithms and machine learning (Maasen and Sutter 2016; Aykut et al. 2019). Recent research on ‘algorithmic governance’, as the governance of algorithms (Barocas et al. 2013; Zarsky 2016) but also as forms of governance *based on* algorithmically mediated processes (Danaher 2016; Introna 2016) and as an emerging mode of governmentality (Miller 2004; Introna 2016) demonstrates the requirement to attend to the specific temporalities and norms inscribed into such data-driven mediations of future-oriented

decisions (Amoore 2013). Current political, public, and scientific debates on transformations of governance through digitisation invoke quite different and competing imaginaries of the future, and thereby highlight the potential formatting of futures through digital governance technologies in the present. By the same token, qualitative methods of forecasting – such as Delphi, scenarios, panels, FET (future emerging technologies), futuring, serious games – are being employed to predict the future in order to advise political decision-makers and economic actors as well as NGOs and activists (Ballesterio 2019; Schultz-Scheffer and Meister 2019).

Anticipatory practices for governance purposes (“prediction-for-policy”, Aykut et al. 2019) resonate with the two distinctive dimensions of ‘fixing futures’ with which the research training group will engage, namely stabilisation and repair. Investments in future-making are defined by the **stabilisation** of certain versions of the future while others are undone. Governance practices fix basic properties and material infrastructures of individual choice and communal and societal routines such as certain mobilities, networks, modes of communication, or epistemic cultures. Contrary to imaginaries of ‘rational choice’ or ‘free will’, stabilisation highlights the emerging foundations, dependencies, and restrictions of action and the limited capacities and contingencies bound to them. Governing the future rests heavily on existing data and infrastructures and is more often responsive to the past rather than purely prognostic of the future (Hull 2012). Studying attempts to fix futures thus opens up the analysis of technologies and medialities to political questions concerning which ways of life are preferred or to be avoided. For example, this is the case in conceiving and designing “smart cities” as the technological fix for current urban challenges and conflicts (Farías and Widmer 2017; Klauser and Söderström 2015), resulting in what Dourish (2016) has called an “accidentally smart city” rather than following a master plan. Additionally, the notion of stabilisation sheds light on how technologies of anticipation mobilise resources and direct public attention. Governmental agencies, by their future-makings, declare a set of problems as the primary ones meaning that other problems that have not been selected, or indeed have been forcefully excluded or suppressed, will not be on the agenda. This is true for traffic systems, energy networks, water management systems, and health infrastructure. The featured future is backwards-oriented in terms of past presents where certain obstacles have not yet been recognised and realised. This is currently being discussed in climate politics, where any renewal of near and not so near futures has to be stabilised immediately through decisions and socio-material implementations. Thinking of the present as future history (Ballesterio 2019) requires attending to both the ruptures and the continuities of forms and issues of governance.

Changes in public policy are often instigated by hopes that it will be possible to **repair** damaged futures. This is particularly obvious in recent research on “transformation instruments” such as participatory multi-stakeholder processes and deliberative governance. Studies on urban security politics (Zeiderman 2016) or on emergency provisions and civil protection (Deville and Guggenheim 2017), for example, demonstrate how future-making in many cases builds incrementally on pre-existing measures and structures designed to handle risk, minimise the effects of potential disasters and create forms of protection and care. On a global scale, especially in the realm of climate engineering and governance of environmental sustainability, more attention is also being paid to emerging “future objects” such as foresight conferences (Esguerra 2019) or climate summits (Laux 2017). This research is slowly shifting the characteristics of anticipation politics towards more speculative approaches. Another globally relevant policy domain where predictive expertise and expectation work are becoming increasingly important is the need to avert widespread food scarcities (Brandl 2017) as one of the expected long-term effects of climate change. The concern with future food insecurities is also an important driver of agri-environmental governance, food quality policies,

and regional development in Europe, as efforts are made to repair the detrimental effects of 20th century modernisation (Welz 2012; 2015; 2018).

Therefore, the notions of modernity, progress and growth that dominated visions of societal futures throughout the 20th century have recently shifted towards the notion of sustainability. Against the backdrop of climate change, ecological catastrophes and the Anthropocene, the notion of sustainability is relating futures to material realities (Adam and Groves 2007). To achieve ecologically responsible and healthy lifestyles is a goal that motivates growing segments of the population in modern societies of the 21st century to make consumption choices that align an ethnic lifestyle with possible futures (Meckin and Balmer 2018). The notion of sustainability implies an orientation to the future that acknowledges both the vital needs of future generations and those of the biosphere. While the concept of sustainability is heterogeneous and contradictory (Neckel et al. 2018), it has been taken up in a large number of research programmes and disciplines. Most recently, the concept of the Anthropocene has prominently posited the present as a tipping point between past and future (Knox 2020). Despite its status as a contested geological time period, the urgency evoked by the Anthropocene concept is nonetheless altering understandings of politics and governance by foregrounding the more-than-human (Biermann 2014; Dryzek and Pickering 2018; Bornemann 2019), raising important questions of agency, accountability, and ecological justice as a geosocial issue (Latour 2018).

2.1.2.3. *Research Field 3: Life*

In a certain sense, it is impossible to define the future in any other terms than as the sustenance of life. And yet, what counts as life and how it is maintained has gone through radical transformations in recent decades (Rose 2007; Helmreich 2009; Lemke 2011). New technologies of prediction and technoscientific knowledges such as genetic testing (see Lemke 2004; Kollek and Lemke 2008; Lemke and Rüppel 2017), environmental epigenetics (Niewöhner 2015b; Müller 2017; Müller et al. 2017), and genome editing using the CRISPR/Cas9 method (Reis et al. 2014; Beisel and Ganle 2019; Kirksey 2020) have transformed the meaning and materiality of life itself. The growing transnational importance of bioscientific knowledges and biotechnologies is increasingly caught up in “political economies of hope” (Novas 2006) and the production of value (Sunder Rajan 2006; 2012). This development represents a horizon of speculation and a form of “promissory capital” (Thompson 2005; Fortun 2008) that materialises in the present to sustain, improve, foster, or control processes of life (Adams et al. 2009; Taussig et al. 2013). Reproductive cells, human tissue, genetic information, and clinical and epidemiological data have acquired economic salience, and the emerging bioeconomies encompass, among other things, risk assessment, predictive testing, and biobanking structures (Cooper and Waldby 2014; Pavone and Goven 2017; Waldby 2019). Along with these developments – often suggesting a “genetic fix” (Etzioni 1973) – new social configurations are emerging that increasingly contest the strict separation between nature and culture, the human and the nonhuman, and the organic and the technological, making way for hybrid entities and identities (Haraway 1991; Rabinow 2004; Gibbon and Novas 2007). The third research field of *Fixing Futures* is therefore concerned with the ways in which ecologies of life shape and change anticipatory temporalities and practices.

Technoscientific options are often connected with forms of prediction, prevention, or preparedness that suggest security and reliability, employing infrastructures and devices of calculation and control (Klausner et al. 2015; Niewöhner 2015a; Murphy 2017). These strategies of **stabilisation** not only inform several forms of neurobiological or genetic diagnosis

but are also evident in the recent upturn of cryobiology. As more and more types of tissues and cellular material can be frozen, stored, and thawed again without any detectable loss of vitality, cryobiological practices not only become an important infrastructural prerequisite for many medical applications and a significant driver for innovations in the life sciences but also represent crucial options for individual family planning decisions (Martin 2010; van de Wiel 2015), regenerative therapies (Haw 2016), and the preservation of global biodiversity (van Dooren 2017). In keeping the vital processes of body parts and organic substances in a liminal state between life and death, these practices produce a specific form of life, “suspended life” (Lemke 2021a). Similarly, visions of personalised medicine as another means of stabilising the present and future seem to be within reach (Prainsack 2017), promising the development of patient-tailored treatments on the basis of predicted therapeutic responses and clinical risk. Yet another example of contemporary technoscientific attempts to stabilise the future is the intensified datafication and biometrification of human bodies, something that includes both the context of migration and border control (Dijstelbloem and Meijer 2011; Barla 2016; 2019; Follis 2017) and everyday technologies of tracking and controlling mobilities and circulations (Suchman et al. 2017). These technologies of future-making are often characterised by entanglements of hope and fear, linking epistemic orientations to moral imperatives (Hvidbak et al. 2011; Lemke 2014). One example of this can be found in practices of egg freezing, which intersect with different temporalities and modes of anticipation that seek to govern reproductive processes and bodily futures. Here, the idea of a ‘biological clock’ that needs to be synchronised and aligned with other life cycles (for example, professional life and emotional life) seems to be of central importance (Waldby 2019; van de Wiel 2020).

Against the backdrop of global warming, environmental destruction, and mass extinction more and more attempts to use science, technology, and engineering to **repair** and restore biodiversity and ecosystem services are emerging. Initiatives such as floating barriers for filtering (micro-)plastic out of the oceans or techniques for removing carbon dioxide (CO₂) from the atmosphere in order to mitigate global warming are but a few examples of this trend (Keith 2009; Sigler 2014). Privileging an “environmental fix” (Braun 2015: 2), these approaches address the problems of climate change and ecological devastation by suggesting, for example, interventions in the shape of geoengineering and terraforming (Lynas 2012; Hartman 2017), the strategic use of transgenic organisms (Holmberg 2010; Kinchy 2012), or the resurrection of extinct species by genetic and reproductive technologies (O’Connor 2015; Shapiro 2015), raising important societal, ethical, and ecological questions. Repairing, here, often involves a strong affective side as the target of fixing is that which ‘we’ care about and hence want to conserve. Caring, however, is an inherently ambivalent practice, “a human trouble, but this does not make of care a human-only matter” (Puig de la Bellacasa 2017: 2). It is for this reason that the practices of fixing also prompt our attention to the interconnectedness and interdependence of humans and other life forms, providing scholars in STS with novel tools and concepts for exploring questions of life and death in a more-than-human world (Kirksey and Helmreich 2010; Locke and Muenster 2015; Barla and Hubatschke 2018; Lemke 2021b).

In their aim of conserving not only life but also specific modes of production and reproduction, both dimensions of future-making are characterised by a double movement: in the very moment that we attempt to fix the future, we are running the risk of being fixed by the very future we enact. As “the dominant paradigm for the administration of life” (Nelson 2014: 2; see also Walker and Cooper 2011), the calls for resilience and preparedness that are gaining traction in the face of social, economic, and ecological crises are an example of how fixing the future comes at a price. Not only do they prioritise the management of and adaptation to natural and human-caused threats, rather than dealing with the causes of the threats, but these calls

also render alternative paths and futures improbable. In order to understand how the future is fixed through practices of stabilising and repairing, there is a need for deeper-going analyses that explore how processes of anticipation become embedded in technologies targeting life itself, seeking to calculate and control the dynamics and contingencies of vital processes.

2.1.3. Possible Dissertation Topics and Supervision Constellations

The doctoral researchers will be expected to write their dissertation in one of the fields outlined above. Rather than attending to ‘stabilisation’ and ‘repair’ as self-contained dimensions, the fields will intersect on different analytical layers in the doctoral projects. Ideally, the postdoctoral projects will investigate differences and/or similarities between two research areas, e.g. investigating contemporary strategies to establish a future “bioeconomy” (Mittra and Zoukas 2020) addressing the shift from fossil to renewable resources, thus bringing together “economies” and “life”.

The following chart illustrates some exemplary topics for doctoral theses as well as potential supervision teams.

ECONOMIES	GOVERNANCE	LIFE
Platform Geographies: Analysing the Algorithmic Coordination of Urban On-Demand Economies	Solving Real-Life Problems at Play: Serious Games as a Forecasting Tool in Predictive Research	CRISPR/Cas9 and Crop Design: Shaping Agricultural Futures through Targeted Genome Editing
Smart Technologies in the Workplace and the Ever New Spirit of Capitalism	Exploring the Policy World of Algorithms: Visions and Technologies of Fairness in EU Governance of Machine Learning	Anticipating Disasters: Investigating the Politics and Imaginations of Geoengineering and Terraforming
Decentralised Futures: The Political Rationalities of Blockchain Based Peer-to-Peer Markets	Designing Future Foods: Researching Nutrition Alternatives to Conventional Food Products	Controlling Health, Preventing Disease: Exploring Multiple Pathways in Personalised Medicine
Forecast Based Financing and Catastrophe Bonds: Exploring Calculations of Humanitarian Futures	Producing Safety, Reaffirming Social Inequality? Ethnographic Case Studies of Predictive Policing in Two European Metropolises	Risky Subjects or Subjects at Risk? Examining Genetic Testing for Susceptibility to Aggression and Violence
Experimental Futures: Exploring Geographies of Evidentiary Practices in Economics	Contested Imaginaries of Future Urban Mobility: Exploring Political Practices of On- and Offline Publics	Prolonging Life, Reversing Death? Analysing Cryonic Practices in Germany and Switzerland

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