Dialogues between artistic research and science and technology studies: an introduction

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1 Dialogues between Artistic Research and Science and Technology Studies

An Introduction

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The past two decades have witnessed a new convergence between artistic and scientific ways of knowing and making. Artists not only increasingly draw upon developments in science and technology, but artistic practices are also seen now as the locus of research, presented to and evaluated in art worlds and academia. Scientists are interested in how the arts can contribute to generating new forms of knowledge, methodologies, and engagements. In this book, we aim to explore this convergence from the perspective of two interdisciplinary fields, artistic research and science and technology studies (STS). Artistic research, or research in and through art and design, has gained currency since the 1990s in and beyond higher arts education. Artist-scholars in this field focus on the knowledge, understanding, and experiences enacted in creative processes and embodied in artistic products such as artworks, compositions, and performances. The field of STS has been growing since the 1960s when it was first established by scientists and engineers who were critical of new techniques and developments emerging from science such as genetic engineering, the growing environmental crisis, and the spread and impact of large-scale technological systems such as nuclear power. It now provides a deep understanding of how science and technology work internally, as institutions, and as a body of practices that permeate almost all areas of modern life. In this Introduction, we argue that a dialogue between the two fields can contribute to a reflection on their epistemologies, methodologies, and the ways in which their research outcomes can become public.

STS scholars have studied the arts in relation to questions about science and its history, exploring the role of artists in creating the visual apparatus used by scientists (Jones & Galison, 2014) or the transport of musical notation conventions to the study of sounds and acoustics (Bruyninckx, 2018), to give two examples. Recently, work in STS has focused on the backstage, practical, and preparatory activities constituting works of art or people's engagement with these works (Saaze, 2013). The interest in artistic practices can be linked to research agendas in STS such as subjectivity and the senses; technology and materiality; boundary work; and embodied, situated, and enacted forms of cognition (Benschop, 2009). STS emphasizes the constitutive role of material and social practices in the production of knowledge and technologies. This 'practice turn' is also manifest in the field of artistic research, positioned at the interface of art worlds and academic research. In artistic research, creating performances or artefacts becomes the vehicle in a methodological sense through which knowledge and understanding can be gained. Epistemologically these artefacts and performances embody the knowledge and understanding we gain.

The type of research that we are interested in in this book does not easily fit the conventional frameworks and values of actors and institutions in science and technology as well as in art worlds. One might even argue that the term 'dialogues' in the title is misleading because the convergence between artistic and scientific ways of knowing has been accompanied by controversies (Borgdorff, 2012), some of which will be discussed in this volume.[1] These focus mainly on the demarcation of scientific and artistic practices, their institutions, and the criteria according to which their outcomes are to be valued. For some in the art world, artistic research undermines the modernist dichotomy of autonomy and instrumentalism, breaking away from the alleged 'otherness' of art as a societal domain that has clear boundaries and that can be separated from science (Nowotny, 2010, p. xx). In academia, taking art to be a form of doing research and presenting the works of art that result from that research as a form of knowledge is criticized as conflicting with standards of intersubjectivity, detachment, and justification.

The debate on art as research addresses fundamental philosophical questions of epistemology and methodology and issues of artistic agency and autonomy, as well as institutional and educational strategies. When does art practice count as research? What is the object of artistic research and in what ways is it different from the object of scientific research? How can scientific knowledge be distinguished from knowledge generated within artistic practice? Are scientific research methods radically different from artistic methods of research? In the debates on these questions, one encounters powerful dualisms: art and science, worlds and words, art practice and writing, embodied and discursive knowledge, original artworks and their representations. As a practice, art is often taken to be a paragon of unmethodological, autonomous, and intuitive work, while science appears as methodological, intersubjective, and articulate (Benschop, Peters, & Lemmens, 2014).

Dismantling dualisms and showing how the distinctions they articulate are constructed rather than given belongs to the core strategies of science and technology studies. Transferred to the demarcation debates around art as research, some scholars have followed this strategy by focusing on the sociomaterial practices that bring artworks into being, rather than on their construction as a singular work that can be (re)presented and categorized in a more or less unproblematic way (Latour & Lowe, 2011; Saaze, 2013). A similar genealogical approach that does not take the artwork 'itself' for granted is advocated by Howard Becker, providing insights into how these 'objects and performances take their shape within the daily labour of artists and their collaborators' (Becker, Faulkner, & Kirshenblatt-Gimblett, 2006, p. 13). Following this line of argument, in this book we aim to move beyond the common-knowledge and the self-understandings of science and the arts and instead study and analyze what artist-researchers actually do (Acord & DeNora, 2008; Becker, 2008).

From an STS perspective, it is interesting to explore how distinctions between aesthetic and epistemic outcomes and criteria are crafted by artistic researchers and the respective communities to which they present their work. In addition, artistic research may enrich the methodological repertoire in STS. Artistic researchers in turn, will find much in STS that allows them to reflect in novel ways on their own practices, as Nowotny has argued (2010, p. xxii). In this introductory chapter, we will set the stage for the various dialogues, practices, and experiments at the nexus between artistic research and science and technology studies that are presented in this volume. To do so, we will first focus on the practices, methods, and outcomes of artistic research as an emerging field. We will then ask how research in STS could investigate and inform the work done in artistic research, and how artistic research can inform and enrich STS. Finally, we will argue that STS can provide a meta-perspective on the new 'knowing spaces' (Law, 2017) evolving around the intersection of artistic research practices and science and technology studies.

Artistic Research as Program and Practice

Artistic research gained currency in and beyond higher education and research in the last two decades, yet its genealogy can be traced back to the early modern period. At least in European history, the birth of modern science did not imply a departure from artistry and aesthetics. The inherited unity of truth, goodness, and beauty, however, was broken when the life spheres of science, morality, and art grew apart since the eighteenth century. Institutionally and theoretically, these spheres developed into the relatively autonomous realms and institutes of epistemology and science, ethics and law or religion, and aesthetics and art. But since the days of Leonardo da Vinci those demarcations have also always been accompanied by a feeling of discomfort and anxiety, and every now and then attempts were made to overcome the pain of the dissociations. A history of artistic research will have to uncover in detail what moments in the course of time attest of that desire to bridge the domains or to traverse their boundaries. In philosophical aesthetics important moments were when in eighteenth-century rationalism 'sensuous knowledge' was emancipated from its inferior position to an equal, albeit distinctive footing (cf. Kjørup, 2006) or when in German idealism it was proclaimed that 'all art should become science and all science art; poetry and philosophy should be made one' (Schlegel, 1991, p. 14).

In the twentieth century, the emergence of the artistic research program was anticipated by developments in both academia and the art world. The acknowledgment of know-how (Ryle, 1949) and implicit or tacit knowledge (Polanyi, 1958; 1966) as constitutive for the way we understand and act in the world corrected the focus in epistemology on propositional forms of knowing and understanding: a correction correlating to phenomenology, that would eventually also be taken up by contemporary non-reductive cognitive science (Gibson, 1979; Hutchins, 1995; Ingold, 2000; Newen, De Bruin, & Gallagher, 2018). In the art world, the artistic research program was prepared by a proliferation of art-science encounters and collaborations throughout the twentieth century (cf. Sormani, Carbone, & Gisler, 2018) and by the advance of conceptual art since the 1950s.

An important impetus for the advance of artistic research was the reorganization of higher education, especially the inclusion of art schools and academies in the university system of higher education and research. Starting in the English-speaking world (UK, Canada, Australia (see UK Council for Graduate Education, 1997; Strand, 1998), it reached the European continent in the early twenty-first century. The transformation from vocational training programs to university programs involved the introduction of research in the curricula of art departments, paired with the requirement for research output by faculty, mostly practicing artists, of those departments.[2]

The focus in artistic research is on concrete practices and things – creative processes in the studio, performances, compositions, artworks, installations, artistic interventions. These practices and things not only are the object of study, as in traditional humanities or social science research into the arts, rather their agency and

performativity is acknowledged and foregrounded. Artworks and artistic practices do something in the sense that they contribute to our knowledge and understanding of the world. This is in line with what is called the practice turn and the material turn in the sciences and humanities (Schatzki, Knorr-Cetina, & Savigny, 2001). Our changed understanding of what practices and things are has renewed the interest in their ontology. Practices and things speak to us – or speak back to us (see Bal, 2002, p. 61). In an epistemological sense they embody knowledge and understanding, and they are methodologically constitutive in producing knowledge and understanding. These insights are also acknowledged in cultural studies, anthropology, heritage studies (Ingold, 2013), and what is called New Materialism, object oriented ontology, or speculative realism (Barad, 2007, cf. Dolphijn & Van der Tuin, 2013)).

Artistic researchers use a diverse range of methods and tools. This methodological pluralism (Borgdorff, 2012; Hannula, Suoranta, & Vadén, 2014) is widely accepted in the field. Depending on the research topic and the aim of the research, one might use methods and techniques that have their provenance in the humanities or in the social sciences or in technology or in a combination, a triangulation of various methods and tools. That being said, one could distinguish between three aspects that are almost always present when conducting an artistic research project. The first is experimentation (Schwab, 2016). The research takes place through and unfolds in artistic practice, in and through making and performing. That is why it is sometimes referred to as studio-based research. The objective of the artistic experiment is not so much to test something – as in a science or engineering laboratory – but to tell something, to convey content. Testing is all about commensuration and standardization (Pinch, forthcoming), but in telling no appeal needs to be made to commensuration. A second characteristic of artistic research is the involvement and engagement of the person or persons who perform the research. Artistic research is participatory research, and as such it shows kinship with ethnography, where the subject–object divide or the fact–value dichotomy are relativized (Atkinson, Coffey, Delamont, Lofland, & Lofland, 2007; Pink, Hubbard, O'Neill, & Radley, 2010). A third feature of artistic research is that the research findings need a form of analysis or interpretation. Here, 'theory' might help to contextualize the research and to show how it relates to other research and how it is embedded in academic, cultural, social, or political spheres and discourses. Artistic research thus appropriates a wide variety of research methods and techniques from other research fields, and it is distinctive in the combination of experimentation, participation, and interpretation.

To demarcate artistic research from other types of research it is generally agreed in the field that artworks, varying from concrete, material artefacts to ephemeral performances or artist interventions, should be part of the outcome of the investigation. The material outcome of the research, however, is not the research itself. Even the documentation of the research outcome, varying from audio or video registrations of performances to exhibition catalogues and so-called 'artist-books,' does not suffice as an account of the research. Additional work has to be done to articulate and communicate the research, to show that it involves 'a process of investigation leading to new insights, effectively shared' (Research Excellence Framework, 2011, p. 48).

In the debate on artistic research, many have taken the position that this additional work is to be seen as the reflective, discursive, or written part of the research or of the submission of a PhD thesis. Hence, there is a sharp distinction between the artwork and the reflection on it.[3] But that position misses the point of the intertwinement of theory and practice in artistic research. If we acknowledge the agency of material

practices and things, and if we stress the importance of studio-based, practice-based methods, and if we furthermore acknowledge that cognition is embodied, embedded, and enacted in material practices, then we should not hesitate to conclude that the reasoning is also located in those material practices. One should at least take the agency: that is, the epistemic and methodological force of the artefacts and artistic practices into account, something that is also acknowledged in STS.

How to articulate this style of reasoning? How to articulate the epistemic and methodological force of art? Here we want to underline the role of rich-media articulation, documentation, publication, and dissemination. This is a form of articulation – of writing, one could say – in which artistic material and its documentation is interwoven with text-based material. One of the tasks now is to rethink what 'discursivity' means, what it is to make a claim in and through art, what reasoning is, once we have accepted that material practices and things in this field of inquiry are not only constitutive in a methodological sense but that they also count as valid expressions of research processes and outcomes. Questions such as these have also been taken up in the field of science and technology studies.

An STS Perspective on Artistic Research

Science and technology studies originated in the 1960s in the critical debates on the societal role and impact of scientific research and technological innovations. This criticism was informed by the debate over the role of the social in the history and philosophy of science. Proponents of internalism, typically philosophers such as Karl Popper (1963), claimed that scientific knowledge production is relatively independent of the social, whereas historians such as Thomas Kuhn (1962) argued that the history and dynamics of science cannot be described and understood without taking social factors into account. This debate over the role of the social resonated with the distinction that Popper made between the context of scientific discovery and the context of justification. Kuhn, Paul Feyerabend (2010), and others showed that even the justification of science is co-dependent on contingent factors sometimes from outside the realm of science.

The Sociology of Scientific Knowledge (SSK) and especially the 'Strong Programme' of the Edinburgh School in the 1970s and 1980s pushed the place of social explanation further by seeking to explain how both false and true knowledge claims are socially shaped. In the same period, scholars from the Bath School and its 'Empirical Programme of Relativism' (EPOR) focused more closely on the concrete, material work scientists engage in through ethnographic studies, studies of scientific controversies, and of science-in-the-making (Bloor, 1976; Collins, 1985). Those studies reached beyond or behind the formal reports and protocols of science and focused on the often implicit, tacit knowledge and know-how and the embodied skills that feed into the research processes and marked the outcomes. A landmark study was the ethnographic research that Bruno Latour and Steve Woolgar conducted in a scientific laboratory in the late 1970s, where they followed the everyday work of scientists constructing scientific facts (Latour & Woolgar, 1979).

In the early 1980s, the symmetry principle of the sociology of scientific knowledge – explaining both false and true knowledge claims from social factors – was introduced in research on why some technological innovations were successful and others not. Drawing on the history of the bicycle, Pinch and Bijker (1984) showed that as an artefact the bicycle was interpreted in different ways by different social groups until

one interpretation of the bicycle stabilized. Their Social Construction of Technology (SCOT) program aims to understand which cultural, economic, social, and political factors co-determine the course of technological developments. Subsequent research on the social shaping of technology has focused on issues such as the non-linearity of technological innovations, the role of users and non-users in these innovation trajectories, and the ways new technologies are shaped by path-dependency and obduracies (MacKenzie & Wajcman, 1999; Oudshoorn & Pinch, 2003).

In the 1990s, the scholarly debate in STS focused partly on the criticism that too much explanatory force was given to human and social factors, as if the internal logic and dynamics of science can be understood by looking at the intended and unintended actions and interpretations of people alone. Proponents of actor–network theory (ANT) argued for a 'principle of generalized symmetry': to understand scientific, technological, or other practices, we should depart from a priori dualisms between the social and the material or between culture and nature (Latour, 2005). Instead, we should develop a relational account of practices as heterogeneous assemblages of people and their ideas and skills, social institutions and organizations, as well as things such as technical objects, materialities, and apparatuses. Instead of being presented as explanation, the social itself is seen to be constituted, staged, or assembled through the interplay between human and non-human actors. This implies an 'ontological multiplicity': reality is not one thing, nor is it given, but it is constructed, staged, and performed and contingent on how human and non-human actors interact (Mol, 2002).

From the early days of ethnographic laboratory studies, following the actors has been a key research strategy in STS. As an empirical enterprise, it seeks to unravel the dynamics of science and technology-in-the-making, by studying practices. Another characteristic of STS methodologies is a focus on case studies, ranging from bicycles to automated subway trains, bridges, contraceptives, air pumps, and bush pumps.[4] Stabilization of these artefacts and innovations in networks and practices cannot be explained only from their intrinsic properties or qualities but should take into account local circumstances and contingencies. STS case studies often share the core argument that things could have been otherwise. This motto reflects the critical origins of the field, arguing against technological determinism and its agenda of democratizing science and technology by making their development more inclusive and reflexive. Showing how science and technology are socially shaped in their making and use enabled STS researcher to locate and rethink normativities and politics as they emerge in practices. Recently, this study of politics in action has been expanded to the normativity of artistic practices to understand how aesthetic judgments are made (cf. Peters, this volume).

How could STS research inform and inspire the work done in artistic research? To begin with, drawing on its science research, STS can help to analyze how artistic research establishes itself as an emerging field and how knowledge claims are made in this field. Furthermore, its focus on the study of practices as sociomaterial assemblages fits well with the interest in practices in artistic research, as well as the materialities, embodied skills, and sensory knowledge that play an important role in these practices. In addition, the sensitivity for how methods shape the realities that they aim to research resonates with the performative force of studio-based methods in artistic research. And finally, STS shows an interest in how the epistemic and methodological force of art can be articulated and made public through rich-media documentation, publication, and dissemination.

Artistic Research, STS, and Their Knowing Spaces

After our concise and admittedly sketchy overviews of the two fields that this book intends to bring into dialogue, we want to elaborate on the question why and how such a dialogue can be fruitful for both fields. We will map some of the common ground to be found at the level of knowledge production, research methods, and outcomes. We will then argue that the intersections of artistic research practices and science and technology studies can be thought of as new 'knowing spaces' (Law, 2017).

To create works of art or performances, artists have always reworked and adapted existing art, mobilized contexts and sources relevant to their art-making, and developed new skills and technologies. The field of artistic research, however, has made this work more explicit as a form of research that entails knowledge claims. Artistic researchers not only present their art as works or practices that are acknowledged and evaluated in art worlds, they also stage the research that their art-making requires and implies in ways that allow academic communities or other relevant communities to assess its epistemic value. They thus expand the ways in which their artworks and artistic practices can exist and be made relevant. An encounter between artistic research and STS involves asking what kind of knowledge artistic research produces and how its knowledge claims relate to traditional scientific ways of knowing. As Salter, Burri, and Dumit (2017) have argued, art and design as knowledge practices highlight the role of improvisation, creativity, and invention. These practices put embodied knowledge center stage, as well as material engagement and forms of sensory perception. With STS, they share a keen interest in performance and performativity, as well as in the agency situated in material artefacts. Finally, artistic research as knowledge practice is characterized by an interventionist approach that stages different forms of engagement and critique. All of this resonates with work in STS on situated knowledges and situated action where knowing, doing, and making as cognitive and perceptual, embodied and sensory, as well as materially mediated activities are intimately related (Suchman, 2007).

A central insight in STS is that research methods do not only observe and represent materials, issues, and events but in fact act upon and intervene in these materials, issues, and events. Research not only analyzes, documents, and informs, but also performs realities and ontologies and reforms and transforms them through the act of researching (Law, 2004). Changing conceptions of what constitutes the empirical also led to an intensification of interest in research methods as ways of making knowledge in social and cultural research (Lury & Wakeford, 2012). STS and artistic research share the project of enlarging their methodological repertoires, as well as the reflection on the politics of what Law and Ruppert have called 'the material heterogeneities of knowing' (2016, p. 20). Ethnography is an example of how social sciences and artistic practice can share a research method, that through its use in these two different contexts can acquire new sensitivities (Foster, 1996). Artists created situations in which the familiar and the foreign vacillate. Precisely the mechanisms that determine what we take for granted and what we experience as strange thus become the medium of the artist as ethnographer. It is through their public staging of everyday reality in experimental situations that audiences can look at themselves as anthropologists (Schneider & Wright, 2006).

The need for hybrid forms of publication and dissemination that do justice to the non-verbal, non-propositional nature of research outcomes is felt both in artistic

research and STS. Extended and intermedial publications not only reflect the hybridity of the research and its methods but also of the publics that are addressed. For example, one of the more vexing topics in the debate on the institutionalization of artistic research in academia are the criteria for an artistic research PhD. In universities that allow artistic researchers to defend their research, as a rule a written text next to an artistic product is requested. This requirement shows how the dichotomies between art and academia continue to exist in practice. Reflection on dissemination strategies and formats to make research public is shared with the field of STS. Here, scholars seek ways to communicate their research results also to wider audiences than can be reached through written scientific work as a contribution to the democratization of science and technology (Marres, Guggenheim, & Wilkie, 2018).

John Law has argued that 'knowing and its methods are materially complex and performative webs of practice that imply particular arrays of subjects, objects, expressions or representations, imaginaries, metaphysical assumptions, normativities, and institutions' (Law, 2017, p. 47). He thinks of these heterogeneous arrays as 'knowing spaces' that can have power and obduracy (Law, 2011) Giving the example of academic knowing spaces, Law explains how access to these spaces depends on the ability and willingness to conform to its conventions, procedures, competences, topics, theoretical frameworks, and criteria. He also gives recent examples of unconventional or hybrid knowing spaces that worked through exhibitions, writing poetry, simulations, reciprocal human–animal interactions, art–science interactions, or activism and participatory methods (Law, 2017, p. 48). In his use of the concept of knowing spaces, and by acknowledging that creating different knowing spaces can be slow, hazardous, uncertain and lonely (ibid.), Law applies a typical STS line of argumentation to practices of knowing, their methods, as well as the reception and workings of their outcomes. What is learned from other case studies in STS is valid here as well:

> That methods are shaped by the social; that they also shape, stage, and structure the social; that they are performative and heterogeneously enact objects, worlds, and realities; that they are situated, productive, essentially political, and normative; and that they might be otherwise. (Law, 2017, p. 48)

Dialogues, Practices, Experiments

The chapters in this book all relate to and reflect on the hybrid knowing spaces at the intersections between artistic research and STS. In our ordering of the chapters, we have placed them under three different headings: 'Dialogues,' 'Practices,' and 'Experiments.' The chapters in the first part of the book all discuss general issues and questions around the encounter between artistic research and STS. They thus contribute to the meta-reflexive debate that accompanies this dialogue. The second part of the book focuses on concrete examples of practices of artistic research, and how these practices can be analyzed using STS concepts and methods.[5] The chapters give detailed accounts of these practices, answering the question of what artistic researchers actually do, either by following their work as academic scholars or by recounting their own practices as artist-researcher. The third part of the book is labelled 'Experiments'. The chapters in this section revolve around one of the central affinities between scientific and artistic research: setting up experimental situations that enable the emergence of knowledge and understanding.

Dialogues

Artworks and artistic practices are meaningful in the art world, whereas they also embody or enact knowledge and insights that function as commodities in academia. In his chapter, Henk Borgdorff approaches this problem of demarcation without reproducing conceptual dichotomies by focusing on what happens when artworks and artistic practices 'travel' from the art world to academia, from the realm of the aesthetic to the realm of the epistemic. What kinds of translations, transformations, or transpositions happen here? Borgdorff answers this question by discussing the process of establishing the online Research Catalogue that functions as a platform for the archiving, documentation, management, publication, and dissemination of artistic research.

The theme of translation is also addressed in the chapter by Esa Kirkkopelto. He argues that the relation between STS and artistic research invites a rethinking of procedures of translation. One of the basic operations in science that depends on translation is measurement. In scientific research this implies that the things under study, which are not necessarily human, are made to speak to us, humans and researchers, so that we can understand them. From the artistic research perspective, however, although things and materials speak to us we cannot necessarily understand their talk, let alone translate it into discursive language. Kirkkopelto poses the questions of how, according to STS, objects are constituted in science, how they are constituted in the arts, and how these processes and their results are similar or different.

Whereas the two previous chapters seem to take the ideal-typical character of art and academia as a starting point to reflect on their interrelations, Ruth Benschop puts this dichotomy aside. Her interest is not so much in defining and defending what artistic research may be, as it is in what artistic researchers do and what the good words are to speak about what they do. Her approach is to conduct a thought experiment on the *craft* of artistic research. This thought experiment consists in deliberately misreading or misplacing two examples, both on the brink of art and ethnography, 'as if' they were artistic research. She reads the work of the ethnographer Stefan Hirschauer like an artist, whereas she understands the interventions of the artist Pilvi Takala as an anthropologist or sociologist. Together, both examples suggest non-reductive ways in which we can grasp both the strictness of emerging methods as well as the space for that which escapes such methods, in academic as well as in artistic work.

How artistic research produces knowledge is the topic of a discourse that has accompanied the field from its beginnings. Drawing on theories from STS and philosophy, Nora Vaage takes bioart practices as a starting point for a meta-reflection on the concept of knowledge itself. In recent years, an increasing number of artists are engaging with the biotechnosciences, entering the laboratories to create art *in vivo*. In what sense of the word can we speak about artistic lab practices as producing knowledge? Whereas a common definition of knowledge in epistemology is justified true belief, this definition reduces the role of art to science communication. Vaage argues that a more suitable concept to apply to the meaning-making of art may be wisdom. Considering artistic research as a practice that aims for wisdom might help create a space for such research that is connected to and complements other academic practices, without having to aim for the same forms of knowledge outcomes.

In her chapter, Hannah Rogers argues that science-and-technology-engaged artists are practicing STS by material means. They share STS's concerns: who gets to set the

agenda of science and participate in its workings, and how does science create and maintain its knowledge corpus and related power structures? To see these artists, who are engaged with science and technology, as outside the STS community is a form of boundary-making. Art and science and technology studies (ASTS) is beginning to unpack some of this work and its consequences for STS. Rogers also considers that particular group of contemporary artists, known as bioartists, in order to examine the specific possibilities for overlaps between STS scholarship and artists who are engaged with science and technology. Works like those at SymbioticA, a wet research lab at the University of Western Australia (UWA), should be considered STS by other means: that is, these works engage some of the same issues that science studies engages but do so not by publishing papers but by vesting their ideas into physical and tactical objects.

Practices

Jon Pigott explores how sensibilities and approaches from science and technology studies can help to understand and identify the practice of kinetic sound art. He does so by developing the idea of the 'material system' identified in the work of STS scholars Bruno Latour and John Law and relating it to the object- and material-based technological systems of kinetic sound art. Following the lineage of technologically engaged art practice offers opportunities for an STS of the arts. A first-hand case study of an original kinetic sound piece by the author titled *Electromagnetic Interrogations* (2011–2014) allows further reflection on the artistic construction of technology as well as a consideration of how the making of a technological artwork and the exploration of related STS influenced ideas can be thought of as a single 'method assemblage' (Law, 2004, p. 13). Pigott argues that kinetic sound art often aims to evoke an alternative view of technology as a contingent and evolving system. For these sound artists there is also a tension between communicating this contingent nature of technology and producing technological artworks that will reliably 'perform' and work in the gallery or concert hall. This allows for a reflection on the assemblage nature of methods for simultaneously making connections, insights and artworks.

Johanna Schindler examines in her chapter two collaborative artistic research projects in Germany and Switzerland through ethnographic field research. Interested in the epistemic potential of boundary objects, she focuses on a newly developed digital musical instrument and a computer- and biofeedback-controlled space. The researchers in the projects stemmed from various disciplines such as computer science, musicology, product design, media studies, and media arts. The observed researchers deployed an artistic working mode to create multifunctional objects, which served both as investigative instruments for their research endeavor and as presentation of first results. Even though artistically designed, these objects were neither intended nor considered to be artworks. Rather, they remained works-in-progress and were a first step in the search for an adequate presentation format for the research results. Seeing these objects as boundary objects allows Schindler to show how their design and functionality reflect the researchers' individual backgrounds and research interests and how they structure and re-organize the ongoing research process.

What does lived experience mean in times of environmental crisis? The first-person perspective of the lived body, which in phenomenology is foundational to sensual perception and knowledge creation, seems to be unable to grasp processes on the

planetary scale such as climate change, Desiree Förster claims in her chapter. Given the fact that the environmental crisis is so extensive and neither temporally nor spatially understandable to an individual, scholars have called for a new environmental aesthetic. Such a re-situating of human agency into its natural environment combines several fields in their shared ways of re-thinking subjectivity by emphasizing the role non-human powers and processes play on various levels of life and sense-making. Using concepts from phenomenology, New Materialism, and actor–network theory, Förster explores how new aesthetic practices at the intersection of art and design develop forms of incorporating non-human agencies into the lived and sensual experience or expand the human body towards its animated, vital environment.

Recently, musical practices and their technologies have become a research subject in STS as well as in the related field of sound studies. In his chapter, Peter Peters enters the pipe-organ builder's workshop to study ethnographically how materialities, such as metal, wood, and leather, and skills, such as metal casting and pipe voicing, are made to matter artistically. Organs are considered as aesthetic and technological mirrors of their time, which makes the practices of knowing, making, and performing that revolve around them a strategic research site to explore interrelations of the epistemic and the aesthetic. Peters followed the building of a new Baroque organ in the Orgelpark, a venue in Amsterdam that aims to give the pipe organ a new role in musical life. Through his ethnographical observations, he describes how acquiring historical knowledge of organ-building practices and relearning eighteenth-century artisanal skills enabled the organ builders to create a technical space in which to articulate intellectual, tactile, sensory, or aesthetic reasons for the normative claim that a pipe sounds good.

Experiments

Screens are everywhere. Claude Draude addresses this pervasiveness of computer screens by following a phenomenological conception of screens as mattering only as screens-in-the-world. She discusses characteristics of the computer screen, interweaving basic principles of computing and cultural impact. This discussion and the phenomenological conception of screens provide the basis for experimenting with screenness through art-based research. The focus here is not on the artistic product or object as such but on thinking, reflecting, and perceiving through art-based experimental set-ups, with a special interest in embodiment and site-specific situatedness. The quality of the art-based approach, Draude argues, lies in its power to produce an experimental field of non-standard ways of knowledge production in a technological field. Reviewing her art-based experiments leads Draude to shift the focus for future research from the metaphors derived from optics towards the notion of the screen as a membrane. Thus, the screen's own agency as semi-permeable threshold, as well as its interconnectivity to specific sites, bodies, and contexts can be addressed.

Katherina Vones examines the way in which the ancient practice of alchemy and the figure of the alchemist could be used to offer researchers and practitioners, operating at the boundaries between creative and scientific practice, a model for engaging with the concept of cross-disciplinary knowledge generation. Alchemical practice has been connected to craft practitioners, and in particular goldsmiths and jewelers, from the early modern period onwards. It experienced a resurgence during the New Jewellery movement in the 1970s, where the altered perception of material preciousness

in jewelry prompted some craft practitioners to return to the conceptual paradigms of alchemy in order to define their practice. More recently, Vones finds, the term 'alchemical craft' has been used to describe practices and practitioners who work with novel materials and processes that have been sourced from the laboratories of researchers, often through interdisciplinary collaborative projects supported by an institutional framework. Materials libraries act as modern day alchemical laboratories, where interested artistic practitioners, makers, materials scientists, and academic researchers gather to experience and discuss novel materiality. Thus a tradition of spaces for experimentation such as those secretive but well-documented meetings that took place between like-minded alchemists in sixteenth-century Europe is revived at a time when such interdisciplinary collaborations are encouraged.

Over the past decades, measurements of the brain's electrical activity have moved beyond the neuroscientific laboratory into other domains, including practices of mindfulness training and meditation, hacker spaces, consumer research, the game industry, and also a variety of art-meets-science events. Flora Lysen investigates these art-science works as public experiments: that is, as configurations of unfinished knowledge, developed with participants as they engage with an art-science installation. She argues that such art-science installations, as entangled experiments, can help to reimagine the empirical and conceptual outlines of research into the social brain but that such intra-disciplinary, ontological reflections are also always paired with other logics, including an assumed critical role of art vis-à-vis science, as well as the position of art in potentially stimulating an innovation-oriented neuro-techno-scientific society. Lysen claims that art-science collaborations, most notably those in the field of bioart, often take the form of art that critically elucidates or examines scientific practices. In this line of reasoning, however, art-science collaborations are intermediating between the fields of art and science, yet they rarely constitute genuine artistic research in the sense of a real hybridization of domains.

In his chapter, Philippe Sormani goes back to the ethno-methodological breaching experiments that Harold Garfinkel developed in the 1960s for a methodological reflection on re-enactment as a research strategy. Sormani explores the interplay between performance art and video analysis. More specifically, his chapter revisits a particular position in performance art – Andrea Fraser's institutional critique *qua* filmed intervention – in dialogue with practice-based video analysis, a recent development in ethno-methodology practiced alongside mainstream STS. Sormani examines three media announcements from a developing corpus of video recordings, all of which announce one form or other of 'machine intelligence,' relating to video gaming, neuromorphic computing, and machine learning, respectively. In his contribution to a 'sociology of demonstrations' Sormani draws together insights from the presented analysis at the tricky intersection of performance art, Fraser's institutional critique, and video analysis, if not contemporary art and current STS more broadly.

Notes

1 The central controversy around artistic research involves its legitimacy as a proper academic field of investigation: that is, whether it conforms to the prevailing standards of scientific research with regard to methodology, replicability, reliability, reporting, and so on. In that controversy some people tend to take sides in such a way that a caricature is made of the opponent. Science is curtailed and reduced to a 'scientistic' picture, where everything that falls outside the scope of the controlled experiment is dismissed as pseudo-science or fraud. Others see art as the realm where autonomy and resistance towards standards and restrictions prevail. It is our assumption that such an opposition is not helpful when one wants to understand the rationale and internal dynamics of the artistic research program.

2 Academic drift is not a new phenomenon in higher education. The history of universities shows a frequent adaptation to changing circumstances and the inclusion of more and more areas or ways of investigation, starting with the advance of experimental science itself in the seventeenth century, over the breakdown of natural history and philosophy into the sciences and the rise of and the controversies around social science in the nineteenth century, up until the inclusion of technology and design programs and the unrestrained expansion of academia into all kinds of areas in the twentieth century.

3 One can find such a distinction, for instance, in the regulations for the new artistic doctorate in Sweden, Norway, and Austria.

4 The examples of these canonical 'object lessons' are taken from Bijker (1995), Latour (1992), Winner (1999), Shapin and Schaffer (1985), and De Laet and Mol (2000). The list of examples could easily be expanded.

5 For a comparison of artistic practices and STS practices in the world of sound, see Pinch, 2016.

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