Abstract ›

This paper argues for the involvement of the performing and applied arts in technological development in the field of Responsible Research and Innovation (RRI). It discusses the challenges and the benefits for the arts, and presents existing methods in the field of RRI. It then describes two practical case studies called gameformances carried out by the authors.

Getting our hands dirty with technology:
The role of the performing arts in technological development

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Innledning

Technologies are shaping our intimate lives in ways we cannot simply predict and control. We argue that making 'better' technologies, technologies that can lead to what we call the 'good life', relies on developing ways for technology developers to experiment not only with technical parameters but also with *being with* technology, and the values at stake in these technologies. Involvement from the arts is necessary for this, we argue.

When we say the arts, we mean the performing arts: a) immersive practices that eliminate the distinction between performers and audience through games and play, and b) applied theatre, which includes game-centred practices that address specific challenges in society. Mixing the performing arts, and the professionals who profess them, with scholars in the humanities and social sciences who are already working on technology assessment and Responsible Research and Innovation, provides powerful modes to affect innovators' creations. Bringing expertise from the performing arts to technological development amplifies the impact of applied theatre fields to society as a whole.

The emergent research field of *Responsible Research and Innovation* (RRI) is where researchers from the social sciences, humanities and recently also the arts develop new ways of conducting technology research so that it contributes to social goods and helps tackle big societal challenges. A standard approach to RRI so far consists in presenting proposals, based on research that is either empirical or theoretical, that use rational argumentation to make scientists and policy-makers reflect on the technologies they are developing, before they are implemented through market or policy instruments.

In this paper we supplement cognitive reflection – a key tool in the analytic, nomothetic traditions of the sciences – by developing embodied, associative, idiographic modes of knowledge, whose roots are commonly traced to the humanities and arts (Windelband, 1904; Salvatore and Valsinger, 2010). Tacit and embodied ways of knowing are recognized as crucial also for the sciences, yet the realm of tacit and embodied knowledge is often located at the field or lab bench (Polanyi, 1967; Keller, 1983). We argue that tacit and embodied knowledge can also be mobilized to inform and decide ways of living with technology, outside the lab, for which we also need some modes to experiment. Experimenting with possible moral-material futures is a mode of work where the arts have crucial expertise and insights, we add. Our aim is to help scientists imagine, feel out and play with technological development instead of just thinking about it. By using these alternative methods, researchers are stimulated to reflect *differently* on the ethical values of the technologies they are developing. Understood together with the reflective methods created in the tradition of RRI, this can provide a more holistic methodology that blends practice, reflection and embodied knowledge and feelings, brought forward to, together, inform technology development (Darsø, 2009).

1. Benefits and challenges in existing performing arts and technology collaborations: Why should we care?

In this section we trace the history of opportunities and challenges arising from the collaboration of performing arts and technology. Our contribution – the SHAKE approach – could be understood through the lens of game theory and design, as it is a hybrid form which combines game and performance. But we believe it is more productive to situate and analyze this work from within the broader field of performance theory, as this encompasses not only performance, but also hybrid forms of games, rituals and performance events, which can extend to encompass and operate on scientific performance and practice at the same time as artistic practices. Connecting SHAKE to the history of the performing arts and technology allows us to see more clearly the history of instrumentalizations across hybrid artforms.

Collaboration between the performing arts and technology is a prolific field with a history of its own, even if these practices have happened outside of the umbrella of RRI. Terms such as 'digital performance', 'multimedia theatre', and ´intermedial theatre and performance' have been coined from the beginning of the twenty-first century to describe a broad variety of works in which digital technologies are used extensively in performing arts works (Dixon 2007, Giesekam 2007, Chapple and Kattenbelt, 2006).

The convergence of these two fields gives rise to innovation and enhanced creativity for the disciplines and agents involved. The resulting artworks can, on the one hand, revitalize performance by using state of the art technology. On the other hand, this application challenges the field by forcing its professionals to re-think what constitutes theatre and performance 1.

Since the second half of the twentieth century, there has been a proliferation of collaborations between artists and engineers managed within the frame of the university. The benefits of such an approach are multi-layered, and they are typically celebrated by the involved parties as highly beneficial (Davis, 1973; Sheppard et al., 2008; Miller, 2014). This is because the university expands into new areas of thought, research and development; the engineers experiment with technology through art; the artists challenge artistic conventions; and the industry partners (if there are any) can explore a possible commercialization of the emerging tools and artefacts.

An example of this is the Teleimmersion Laboratory (2005–2011) at the University of California, Berkeley, where engineers invited dancers into their laboratory as they were developing a telematic system (a high-tech form of Skype where agents in remote locations can collaborate in a 3-dimensional environment). The creative experimentation carried out by the dancers allowed the engineers to improve the system's digital options and thus create a better system – or a more complete one (Sheppard et al., 2008). The dancers also got to experiment with the telematic system, which resulted in a "telematic performance" entitled Panorama: a Multimedia Happening (Smith/Wymore Disappearing Acts 2009). In this case, the collaboration between the dancers and engineers benefited both collectives, as they helped each other explore their own interests, while it simultaneously served as a platform for learning for all the students involved in the exchange.

For all that, an increasing number of voices have started to point out the limitations of art and technology collaborations. When discussing telematic art and performance, it has been pointed

1) Some theoretical sources that investigate how different technologies affect different aspects of the performance event are: Hilton, 1993; Giannachi, 2004; Benford and Giannachi, 2011; Auslander, 1999; Berghaus, 2005; Berg, 2005; Lehmann, 2006; Causey, 2006; Chapple and Kattenbelt, 2006; Dixon, 2007; Giesekam, 2007; Balme, 2010; Klich and Scheer, 2012; Pérez 2016.

out that when it comes to the collaboration process, artists and engineers often work 'parallel to each other' rather than 'with each other' (Geelhoed, 2013). It also happens that the collaboration process is experienced as difficult and frustrating for the participants, so that by the time a common understanding is reached, the participants are exhausted and the timeframe and funding about to expire (Geelhoed, 2013). When discussing ubiquitous games and performance, game designer and performance scholar Jane McGonigal has pointed out that there are often problems with the resulting works. For example, due to their high-tech nature, they rarely reach a general audience. The artworks are typically not shown in regular theatre houses, nor do they become part of regular cultural touring circles because the venues cannot provide the appropriate technological means (McGonigal, 2006). As a consequence, high-tech artworks remain hidden away in the laboratories of research institutions, where they are used mainly as academic proof and where they may become part of a 'network of citations' that legitimates the artistic genres within the scientific community while producing research insight (McGonigal 2006). In this sense, the resulting art pieces do not spill down to culture but serve instead as a vision of what the field can be in the future more than representing the state of the art. In some cases, the artworks have been criticized for serving only as technological demonstrations with no aesthetic value in themselves (Berghaus, 2005; McGonigal 2006; Dixon 2007; Pérez 2016). In the latter case, the involved parties resort to what has been called a shock and awe aesthetic that seeks to impress audiences only with dazzling technological displays while neglecting the artistic value of the works (Pérez, 2016).

The performance studies scholar Philip Auslander has argued that the problems arising from the convergence of art/humanities and technology do not have to do with the technologies themselves, but with contextual issues regarding the conditions under which the artworks were created. In an interview, Auslander points towards cultural differences as a major limitation and mentions several problems: making a pretense of collaboration, using different criteria for quality and assessment of the resulting products, and the instrumentalization of the arts by the sciences (2005, 4). With a situation where the pitfalls seem to exceed the benefits, why and on what terms should the performing arts get involved in this?

A possible way to start thinking about where a constructive contribution might lie is given by performance studies scholar Shannon Jackson. Jackson recently reviewed the work of American-based theatre company The Builders Association, who has been engaged in collaborative work with technologists at the university, private sector and others. She argues that the value of their work is how they use technology in their productions while simultaneously criticizing it (Jackson and Weems, 2015).

To us this seems to be a very productive place for technology and performance to be, where they cross-fertilize each other. If we understand performance as contributing to technology´s body of critique and re-constitution to mean that engineers design better technologies that contribute to better lives, then joining performance and technology not only makes sense for both, but it is very necessary for society/for us (see also Feyerabend, 1967).

In this sense, performance is used in an applied manner, similar to how other forms of applied theatre aim to improve the lives of people or empower vulnerable communities (Prentky and Preston, 2009; Nicholson, 2014). Applied theatre often takes a critical standpoint to the mainstream, giving voice and purpose to those in need, making challenges that may be overlooked visible, and so on. In the same way, applied theatre can contribute to ensuring that technology development follows the needs of society. It can reveal instances when this is not the case, and come up with possible solutions on how to proceed further.

We believe that the grand societal challenges like climate change, ageing societies, health, etc. that science and technological development aim to address are in need of expertise and skills from different fields if they are to be tacked, as the problems are complex and cannot be solved easily (Efstathiou, 2016). Socio-humanists (social scientists, historians and philosophers) have for some years now been working alongside technology development to question technical decision-making, engage with broader stakeholders and unpack what kind of challenges technology brings to the fore. We propose that practicing academics, teaching artists and practitioners also need to get involved with the questions that technology poses and to become part of teams of researchers who are attempting to do this.

The problems faced by socio-humanists in scientific collaborations are not insubstantial, and in some ways they mirror the challenges we listed above for art and technology collaborations (cf. Balmer et al. 2015; Nydal et al., 2015). Socio-humanists too suffer from what Williams (2018) calls 'engagement anxiety' – the fear to become manipulated by those we engage with. But these struggles for self-understanding and meaning that applied socio-humanists are facing and the roles they are occupying, are paving the way for a critical artistic and socio-humanist engagement with technology (Calvert and Schyfter, 2017; Kupper, 2017): This is an opportunity to shake established concepts, practices and ethos through interdisciplinary work (Efstathiou and Mirmalek, 2014).

We do not mean to say that engaging with technology in the way performance has done so far is not important: creating a performance about technology, where technology is the explored topic, can be the ideal site for passing a message on. But our aim here is to expand the reach of applied theatre to a site where it is not commonly seen and where it is, we believe, sorely needed: that of technological development.

This paper is an attempt to do this. It aims to use art strategies as method for taking a critical stand towards technology. We are using strategies from the arts to come up with alternative, open ended and non-normative ways of making scientists more aware of the values at stake in the technologies they are developing, as they are developing them. This work we see fit under the remit of an expanded, art-based Responsible Research and Innovation.

2. What is Responsible Research and Innovation?

Responsible Research and Innovation (RRI) is a relatively new science policy concept (von Schomberg, 2011). Its aim is to create transdisciplinary modes to reflect, give feed-back and steer scientific research and technological innovation with the purpose that these will help tackle big societal challenges and contribute to social goods. Research and innovation shape society, but the success of technological innovation requires societal uptake (consider the failure of GMO food in Europe). Consequently, society, ethics, and technology need to be considered together if we are to develop technologies with the societal effects *we want to have*. RRI thus aims at developing democratic means to govern research and innovation. To do this, the actors involved develop *frameworks* for responsible innovation. These frameworks are developed to foster reflection on technology, our evolving relationships to it and on its potential impacts (Stilgoe, Owen and Macnaghten, 2013; De Saille, 2015).

The historical arrangements leading to RRI can be traced back to right after WWII, when the US employed high numbers of researchers fleeing Europe – chemists, physicists, biologists – and a lot of resources were put into developing technology. The atom bomb is an example of the power of well-organized research and innovation. 'The bomb' brought to the fore the positive but also potential negative impacts of new technologies. The latter made manifest the need for new ways,

and institutional bodies, to assess technologies, not only in terms of their technical feasibility but also in terms of their social impacts. The question became not only how to develop but also how to control the 'monster' of technology (cf. Carson 1962; Winner 1980).

One way of managing the potential negative side-effects of scientific and technological innovation was to create a state office to assess technological innovations. The US Office of Technology Assessment was established in 1972 with the purpose of predicting unintended impacts of technology in advance, thus enabling policy makers to take precautionary measures. From the 1970s onwards, citizen groups, social scientists and scientists called for 'socially responsible science' that served society rather than the interests of the military and Big Capital. From the 1980s, the idea that society and technology mutually influence each other gained traction (Jasanoff, 2004; Bijker et al., 1987; Latour, 1988; Wajcman, 1991; Gibbons et al., 1994). This was also the time when controversies regarding new medical technology, like DNA technologies or bio technologies, attracted public attention, where the questions revolved around ethics and which ethical principles could guide the development and use of these new technologies. The new ethical questions that arose in connection with medical and science innovation contributed to the rise of applied ethics (Toulmin, 1982). Here we have some first cases of humanists being involved in the job of being critical to technology, through purpose-made research programs attached to scientific funding exploring the Ethical, Legal and Social Impacts or Aspects (ELSI/A) of the new biotechnologies, for instance concerning the Human Genome Project, completed in 2002. The ELSI/A programs provided some of the first instances of humanities scholars being included in scientific research programs to critically reflect on technologies-in-the-making. This mode of working alongside technologists has now evolved into Responsible Research and Innovation.

Compared to traditional technology assessment and ELSI/ELSA, RRI has three new features. Firstly, RRI integrates critical reflection into technology development instead of commenting on technologies after these have been developed and introduced in society. Secondly, RRI invites contributions to research and innovation from a wide variety of stakeholders, e.g citizens, interest groups, scientists, and other experts. Thirdly, RRI is constructive as opposed to simply restrictive – moving from the negative aim of risk avoidance to the positive aim of co-creating 'the technologies we want to have'.

2.1 Hard and soft impacts

Technology assessment often focuses on technologies' *hard impacts*, leaving their *soft impacts* unquestioned (Swierstra et al., 2009; Swierstra, 2015). *Hard impacts* are the measurable, causally traceable, and morally clear impacts that technologists and policy makers are usually preoccupied with when testing and assessing technologies: for instance their safety (toxicity, flammability etc.) and efficacy (optimality, cost-efficiency etc.). The pollution of a local town's water supply by toxic waste from a nuclear power plant would be a hard impact: it would be possible to measure the pollutants, causally trace them to the technology, and morally assess this as an unwanted impact.

But technologies do not only have hard impacts, nor are these the only ones that are important. 'Soft' impacts typically accompany so-called 'intimate' technologies. Examples of such technologies are the contraceptive pill, brain-computer interfaces, augmented reality, social media, the internet, and mobile phones. These technologies are 'intimate' in the sense that they pervade our everyday lives, exist *in* us, *between* us, and *around* us, shaping ideas about who 'we' are and want to be (Van Est, 2014). They often operate to co-define the good life and what we owe to each other. What is sexuality after the pill? Friendship after Facebook? Working after the internet? Unfortunately, soft

impacts rarely receive the attention they deserve, even if they are crucial for human flourishing and relations. They often disappear from sight because they are typically qualitative rather than quantitative and thus harder to measure; they are enabled or mediated by technologies rather than caused by them, and they are morally unstable because people usually disagree about their moral worth (Swierstra, 2015). Another reason why soft impacts are easily overlooked is that they require abstract and embodied, philosophical engagement and are not typically resolved with the help of generalized rules or principles that can be inscribed into regulations or law. We call soft impacts 'soft' not because they are weak or irrelevant, but rather because they are more difficult to detect and implement and easily get ignored by policy makers.

It is our core contention that we need the 'soft' arts and humanities to help us deal with technology's soft impacts. The arts can help us take a step back, to pause, and to imagine/feel how we live and could live with technologies. Inviting technology developers and stakeholders to investigate together new questions and boundaries of a technology is not an easy task. It implies a significant change in how things are done on many levels. Our idea is that by supplementing the dialogical, verbal, or written approach already implemented by the RRI with a more hands-on, performative one, we might get closer to answering these questions.

3. RRI methods from the humanities

Philosophers working in the field of RRI have created different methods to help scientists reflect on the social and ethical dimensions of the technologies they are creating. These methods are based on 'deliberation' between different actors (designer, engineers, and stakeholders). Implicitly, they create space for engaging with hard impacts, though some of them also engage with soft impacts. We briefly present two approaches here that relate to our own.

1. *Value-Sensitive Design* (VSD) is an approach pioneered in the 1990s by Batya Friedman to reflect on how values play into technological design (2002). VSD is primarily concerned with technology's hard impacts such as ownership and property, privacy, freedom from bias, universal usability, autonomy, informed consent, accountability, and environmental sustainability. It also focuses on certain soft impacts such as human welfare, trust, identity, and calmness.

2. One of the strategies used to reflect on these values are so-called "envisioning cards". These propose situations or cases where the technology developer is to envision handling or dealing with a challenge. The cards can be used to reflect on particular dimensions of technological design. They build on scenario-based approaches to technological design, pursuing reflection through lexical, dialectic means but also mobilizing the participants' technical and moral imagination.

3. *Socio-Technical Integration* (STIR) questions technology development using Socratic pedagogics as inspiration (Fisher and Mahajan, 2006; Fisher et al., 2006). The method brings a socio-humanist/ethicist into the laboratory, who then initiates conversations with a scientist concerning the choices she/he is making in the lab. The interactions are semi-scripted using a "decision protocol" to structure the interviews, as you can read here:

Decision Protocol	*Questions to engage a researcher with:*
opportunity	What opportunity presents itself?
selectors	What are the factors important to consider?
alternatives	What alternative approaches are there?
outcome	What will/did you do?

Table 1. The STIR decision protocol: Four parts of making a decision in the lab.

The protocol is understood as an 'ethnographic intervention' where the socio-humanists not only observe work in the lab, but also intervene, and may in effect steer the decision-making process by asking 'the right' questions, following the old Socratic method of stimulating reflection in an 'expert' partner through conversation (Fisher, 2007).

These are great methods, but they present two pitfalls: Firstly, they focus on intellectual reflection through deliberation and conversation where reason and logic are the basis for understanding. Secondly, even though these approaches were quite radical in their beginnings, there is a danger that any such procedure can become internalized by different agents, degenerating into a questionnaire that one learns to answer 'correctly' (Latimer and Puig de la Bellacasa, 2013; Åm, 2018). In this way, it can happen that the agents involved either answer or delegate answering these questions without really reflecting, and business continues as usual.

4. RRI Methods from the arts

Section two presented some existing, common ways of collaborating in art and technology. Though our approach acknowledges these practices and learns from its benefits and challenges, we want to take a step in a slightly different direction. Our aim is to investigate whether artistic strategies can be used within RRI as methods. To do this, we encourage practicing academics, teaching artists, and practitioners to get involved in interdisciplinary teams of researchers within the field of RRI.

We have found a few attempts at doing this. One is described by theatre scholar Ragnhild Tronstad (2017) and the recent attempt made at Oslo and Akershus University College of Applied Sciences to develop a joint PhD program in technology, engineering, and art and design in which RRI is applied as a unifying, program-defining perspective. Even though this attempt did not ultimately succeed, as the joint PhD did not materialize, it still points towards RRI as a suitable platform where the arts can have a role to play within an educational program.

Another project that has attempted this is one using *a narrative approach.* This method was developed by Davies et al. (2009) and MacNaghten et al. (2015) as part of a EU project (2006–2009) called 'Deepening Ethical Engagement and Participation with Emerging Nanotechnologies (DEEPEN). It was inspired by methods from Augusto Boal's Forum theatre to question existing cultural narratives that enable and constrain individuals' standpoints regarding technology.

The authors organized focus groups where participants discussed diverse aspects of technology in order to make participants aware of unconscious expectations regarding technology´s promises and failures. These talks were then analyzed by the authors and categorized into five large narratives that are universally recognizable: 'Be careful what you wish for'; 'Pandora's Box'; 'Don't mess with the natural order'; 'We are kept in the dark regarding the real motives of elites controlling technological development', and 'The rich get richer'. Even though the authors may have used methods from

forum theatre to facilitate the talks, there seemingly were no embodied, performance-based work besides verbal, intellectual conversations.

5. Our approach: SHAKE

As the name of the method suggests, the SHAKE, the Science, Humanities and Arts Knowledge Exchange, wants *to shake* the landscape of existing methods in RRI, or perhaps also invite it to a dance (do the SHAKE?). We aim for provoking scientists with alternative methods that challenge them to engage with technological development differently. SHAKE does not seek to make scientists 'react' to existing (often negative) technological problems or scenarios (like the narrative approach presented earlier). SHAKE rather seeks to create conditions that encourage social and technology actors to 'produce' different, new, sweet, dreamy, soothing, friendly (good) realities. In this sense, it is a productive tool rather than a reactive one, starting with producing new realities versus reacting to existing ones (Williams, 2018).

In order to flesh out the hybrid form of SHAKE, we are using theoretical sources descending from performance theory on play and games, often used to understand improvisation in theatre and the classroom. We are combining these theoretical insights with current game and play theory about contemporary and experimental gaming practices. The reason is that SHAKE is part game, part performance, and by blending these two fields of knowledge we are able to better flesh out the main characteristics of SHAKE.

SHAKE has two important characteristics: it is participatory – participants have to not only discuss, but *carry out* certain actions, and it is *fun*. It aims at tackling serious, important issues through serious play. The idea of playing as a way of facilitating dealing with difficult, serious issues is central to the rise of the field of improvisation in the 1960s, with practitioners such as Viola Spolin, Clive Barker, and Augusto Boal, to name a few. In recent years, we see a resurgence of this idea in the emergent field of game studies and design, where (video) games are considered to be able to tackle serious issues through ludic activity. For example, one can now play to learn, to work, to consume and *to foster social change.* This idea has materialised in several genres that aim at tackling how games can be used in non-game contexts, resulting in labels such as serious games, persuasive games, games for change, games with an agenda and gamification (Bogost 2007; Montola et al, 2009; Deterding et al. 2011).

These two characteristics of SHAKE are important to us for the following reasons.

Firstly: According to Aristotle´s *Rhetoric*, successful persuasion and critique engages not only reasoning, *logos*, but also *ethos* and *pathos*, character and feelings (Aristotle, 1991). In the model of the Athenian polis, philosophy, democracy, and theatre were developed separately but also synergistically, cultivating the city and its citizens' perspectives in more than one way. We want art-based RRI to contribute to a more holistic method to train stakeholders' abilities to respond to technology: one that recognizes, respects, and incorporates the body and feelings as integral parts of the political, and as such offers a different kind of method for RRI.

Secondly, we want to depart from the existing skeptical take that many analytic approaches to the morality of technology. Our motivation here is to provide a form of play that lowers the threshold for participants to engage with this type of work and makes them feel safe and comfortable. As play is flexible and open-ended, it takes the heat of difficult situations for the participant (Kaprow 1993; Frost and Yarrow, 2007). We hope that scientists will be more open if the methods are not fatalistic and have a more positive tone. Furthermore, serious play allows participants to explore difficult issues while simultaneously providing a wide range of experiences as participants can always *blame*

it on the game (Poremba, 2007). Play serves as an alibi from where to explore issues and do things that one would not normally do. We believe this form to hold critical potential in this particular field.

We will now describe two gameformances we have created to help us achieve our purpose: *the Response-able Walk* and *Virtuous Designs.*

We define 'gameformance' as a hybrid form that mixes the rhetoric of rules and competition found in games with the open-ended language of instructions found in performance. Gameformances are participatory works that give participants a clear framework for action while simultaneously giving them room to explore different directions that appear as the work progresses [2].

Gameformances can be understood as the typical drama exercises/theatre games one finds in the sources dedicated to applied theatre. In this literature, exercises/games are classified according to the purpose one is trying to achieve (theatre for education, theatre for health etc.) and are often connected to specific case studies (Prentky and Preston, 2009; Nicholson, 2014; Prendergast and Saxton, 2016). Other times, the exercises/games are categorized according to the collaborative process or according to topic regardless of the purpose its being applied to (Boal, 2008; Johnstone, 2005). Regardless of how they are categorized, they are presented as tools – together they make a strong toolkit – to be used by teachers in the classroom, by practitioners in an applied theatre setting, or by anyone interested.

Our gameformances could be part of a new section in the applied theatre toolkit that focuses on problematizing technology. They have been devised to help socio-humanists and scientists involved in technology development to broadly engage in a sensual, embodied reflection on technology, in the liminal zone between instrumentalism and determinism concerning technology – that is, treating technologies as mere tools, instruments without any agency – or as actual determinants of social action. These gameformances can be more or less developed, more informal, or made into a proper performance event. In that manner, they are flexible. So far, SHAKE gameformances have been done in classrooms with students within the fields of the umanities and sciences at NTNU, presented and performed at international science and humanities conferences and workshops, and also at performance venues in Greece.

5.1 The Response-able Walk

The Response-able Walk is a gameformance made to stimulate reflection on the limits of individual and collective responsibility. To perform the Response-able Walk, we ideally need a number of participants larger than five able to traverse a space, and a clear space for them to move through. The orchestrator of the walk gives four instructions and she can participate in the walk while giving her instructions:

- First: 'Walk, any way you like'. Usually people will walk alone, with a regular gait, in different directions.

- After a couple of minutes of walking the orchestrator asks people to 'Keep walking, now spot a person and keep walking making sure that this person is always on your LEFT'. This introduces one constraint: modulating your position relative to another person. By this instruction some pairs could form, but people keep walking.

- The instruction is called off, so people can walk freely again, until the orchestrator says: 'Now, keep walking, spot another person, and make sure this person is always

on your RIGHT'. Again, after a slight commotion people keep walking.

- The last instruction combines the last two: 'Now spot TWO people, keep walking, and make sure one is on your LEFT and the other on your RIGHT'.

At this stage, and if there are no physical obstacles in the room, a pattern will form. The clue is that nobody actually knows what pattern, including the orchestrator. It could be a circle, a cluster or clusters, or a line. But all of the participants are implicated in forming this pattern. After the pattern becomes stabilized, the leader ends the exercise and invites participants to discuss their experiences, starting with simple questions like: 'How was this?', 'What did you notice?', 'How did this feel?' etc.

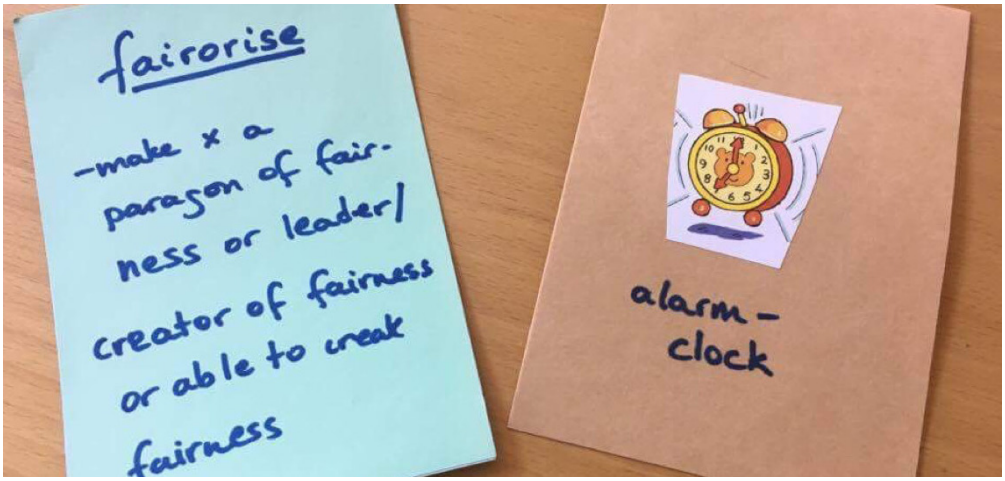
From our experience with orchestrating this exercise, the Response-able Walk creates an encounter with the phenomenon of emergence. Participants report their surprise at being part of a causal process (following instruction) that leads to an outcome (the pattern), which is attributable to your actions, yet not intended by you and not visible to you unless you can see your whole group. Participants in our gameformances will follow instructions and physically position themselves as directed. Yet they will not (consciously) intend to form the pattern that emerges from their collective action. This opens up to reflection on the unintended, collective impacts of our actions, when replicated on a social level. The gameformance thus helps create an embodied encounter with the nature of soft impacts of technology as emergent and social, versus predetermined, anticipated, and intended. In this mode, the Response-able Walk prepares participants for the cognitive and articulated discussion of technological impacts, having started in the realm of the embodied and experienced.

5.2 Virtuous Designs

The gameformance *Virtuous Designs* invites participants to redesign everyday objects and practices by virtues such as courage, fairness, kindness, honesty etc. The gameformance plays on the idea that we can make a better world through technology by overidentifying with that idea: imagining technologies as active paragons of virtue, superheroes! (figure 1.). Participation takes the form of playing a card game, a format popular in collaborative design settings.

Players are divided into teams and each team is asked to pick two cards that face down. One card is drawn from a deck containing actions – 'virtuising verbs' – (blue), and one card is drawn from a deck containing objects, or biological agents, practices, and institutions (brown or pink) (table 2.). An example: The figure 1. team picked an alarm clock that was to be 'fairorised': redesigned into an enabler or creator of fairness. Players are given worksheets where they can name, draw, and describe their invented device, e.g. 'fair clock', in 4 minutes. When the time is up, each team is given 4 more minutes to combine features among their teams' designs and develop an uber-virtuous invention. At the last stage, the teams present their outcomes and everyone votes for their favorite invention. Virtuous Designs uses an invented virtuising vocabulary which is at times self-mocking – for instance *sincenerate,* evoking incinerate, as honesty kills, or *fairorise,* evoking terrorize, as fairness is in the eye of the beholder. The verbs claim it is possible to instill and promote virtue in others. A radical idea, as individualistic ethics usually considers character as a matter of self-development.

The gameformance opens up to imagining designers in a new school of virtuising technical agents (cf. Latour, 1992), stimulating the aspiration that research and innovation can bring about a better, virtuous world. Participants in this game have valued highly the creativity and joy it stimulates. The affective tone of the game is one of fun, loudness, involvement, which is reported



Virtue-ise Verbs	Object/Process/Institution X
1. Deprocrastinate	-Make X prevent or discourage procrastination
2. Fairorise	-Make X a paragon of fairness or a leader/enabler of fairness or able to create fairness
3. Feelify	-Make X inspire emotional intelligence and feeling-awareness
4. Patientise	-Make X inspire patience, produce patience or enable patience
5. Braverise	-Make X inspire braveness or enable braveness
6. Kinderise	-Make X kinder in action or enabling kindness
7. Lovify	-Make X produce lovingness or being lovingly
8. Forgivinate	-Make X inspire forgiveness or enable forgiveness or produce forgiveness
9. Honestify	-Make X honest or honesty conducive
10. Peacefulate	-Make X create or enable peacefulness or make X peacefulness conducive
11. Generositise	-Make X more generous in action or inspiring generosity

12. Respectfulise	-Make X secure or ensure respect
13. Collegialate	-Make X enable collegiality and team spirit
14. Joyrate	-Make X inspire joyfulness or to enable joy
15. Reflectivate	-Make X conduce critical reflection
16. Dedicatise	-Make X produce dedication or commitment, or resilient belief.
17. Enthusirate	-Make X stimulate enthusiasm and motivation
18. Sincenerate	-Make X induce sincerity, reward or encourage sincerity

Table 2. Virtuous Designs: *Virtuising verbs and their meanings*

to be highly valued in academic, 'serious' contexts, and which our participants report could be a great ice-breaker in project settings, where people are not familiar with each other. They are not immediately aware of the philosophical implications or ideas in this play. But the situation of play, absurdity, and amusement stimulates to a further discussion, which the leader of the game can facilitate. Some of the insights we have discussed with participants include a) whether everyday technologies are morally inert, b) why Virtuous Designs are not unimaginable, yet how people can implement the same values on the same object so differently, and c) how we think of virtues and how to implement them. The gameformance is an invitation to re-engineer our environments to open up to virtue, playfully inviting the participants to create these new things, biological agents, processes, or institutions, by combining their imagination, affect and experience.

6. Conclusion

We started this article with questioning whether theatre should get its hands dirty with technology. Should practicing academics, teaching artists, and practitioners collaborate with technologists to create 'better' technologies? Is this advisable? Is it feasible?

These are difficult questions to answer, especially in a general manner. We have discussed the benefits and challenges artists have to consider before joining such endeavors, given the history of theatre and technology. We have also related the difficulty of understanding what *better technologies* actually are, how to deal with different discipline-based understandings of technology and values, how to assess hard and soft impacts while recognizing that technologies are changing our morality, values and experience.

It is precisely because of the difficulty of responding to technology from any single perspective that we see a potential here for art: making use of the performing and applied arts as a method for better technological development, in the same way that different forms of applied theatre aim at using theatre to meet needs of different societal needs. We have created our very own drama exercises – SHAKE gameformances – and brought them into the technologists' classrooms and meetings in an attempt to make our methods impactful in other fields.

Our ambition is to expand the applied theatre repertoire by adding a new, particular form that explicitly reflect on the 'ethics' and 'societal value' of technological development: What we have done so far is seemingly to simply apply existing strategies in a new area. First, our gameformances are very simple exercises that any practicing theatre scholar, teaching artist, or practitioner is familiar with. The gameformances proposed here can be used as ice-breakers before actors start working on the floor, as a way to prepare the body and the mind for the practice. Further, they are not tailor-made to address a specific design process in which particular technologies are produced, as they have not been curated as part of technological development process. Yet, what these modes of working provide is novel, missing, and much needed in this target context of technological assessment and responsible innovation. As such, they do not need to be complex to be of use. Indeed, their complexity might inhibit uptake in these already novel and to various degrees resistant contexts.

We still see ourselves at the beginning of a long road ahead, where our gameformances are a gesture, a one-time event that allows engineers to get a taste of what it would be like to include this kind of practice in their process in a more regular manner and spanning longer periods of time. If art and performance-based methods were part of innovation processes, they could really make a difference, incorporating a broader spectrum of experiences besides the technical-material, to technology development. The practical aspect of our gameformances could well enhance reflection delivered by the humanistic fields involved in the tradition of RRI. The arts and humanities could work together, in a joint effort, with those already involved in these/similar questions in transdisciplinary teams.

The fact of the matter is that our knowledge is needed in other fields. Broadening the possible venues for the use of our aesthetic knowledges is one way of making ourselves socially important, in addition to showing our already existing role in society. Contributing to questions such as 'how to get better technologies that are more democratic, anti-sexist, non-destructive, green etc. is a potential new 'use' of performance. We are aware that the performing and applied arts are not essentially 'good' – they also have their own ethical issues regarding ownership, power, instrumentalization etc. that are particularly visible in immersive works where audiences are invited/instructed to become participants. In this context we believe that addressing soft impacts through an enriched RRI and performing and applied arts mode can possibly create modes of awareness and collaboration beneficial to both fields, and that we can in fact help each other address the ethical issues that come to the fore in both fields. The risk of being instrumentalized, or reversely romanticized, is always there, but we should still become participants in an already ongoing battle to domesticate the monster of technology and to direct it towards better uses than war, profit and alienation. That way we could strengthen our connections to wider societal issues confronting technological development as part of a shared mission, instead of struggling against being or becoming 'the aesthetic alibi' for innovation.

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7. References

Aristotle (1991) *The art of rhetoric*, (trans.) Lawson-Tancred, H., Penguin Books.

Auslander, Philip. 1999. *Liveness: Performance in a Mediatized Culture.* New York: Routledge.

Auslander, Philip. 2005. After Liveness: An E-Interview. In *Performance Paradigm*. Accessed February 20, 2014.

Balme, Christopher. 2010. Distributed Aesthetics: Performance, Media and the Public Sphere. *Blending Media*, edited by Jerzy Limon. Gdańsk: Theatrum Gedanense Foundation.

Balmer A.S., Calvert J., Marris C., et al. (2015) Taking roles in interdisciplinary collaborations: Reflections on working in post-ELSI Spaces in the UK synthetic biology community. *Science and Technology Studies,* 28(3): 3–25.

Benford, Steve and Giannachi, Gabriella. 2011. *Performing Mixed Reality.* Cambridge, MA: MIT Press.

Berg, Ine Therese. 2005. Perspektiver På Multimedial Scenekunst: Monster Teater? *Master Thesis*, University of Oslo.

Berghaus, Günter. 2005. *Avant-Garde Performance: Live Events and Electronic Technologies.* Basingstoke: Palgrave Macmillan.

Bijker, W. E., Hughes, T. P., & Pinch, T. (1987) *The social construction of technological systems: New directions in the sociology and history of technology*. Cambridge, Mass, MIT Press.

Boal, Augusto. 2002. *Games for Actors and Non Actors.* London: Routledge.

Boal, Augusto. 2008. *Theatre of the Oppressed.* London: Pluto Press.

Bogost, Ian. 2007. *Persuasive Games. The Expressive Power of Videogames*. Cambridge, MA: MIT Press.

Calvert, J. & Schyfter, F. (2017) What can science and technology learn from art and design? Reflections on 'Synthetic Aesthetics', *Social Studies of Science*, 47(2): 195–215

Carson, R. (1962) *Silent Spring*, Houghton Mifflin Co.

Causey, Matthew. 2006. *Theatre and Performance in Digital Culture: From Simulation to Embeddedness.* London: Routledge.

Chapple, Freda and Chiel, Kattenbelt, eds. 2006. *Intermediality in Theatre and Performance.*

Amsterdam: Rodopi.

Darsø, L. (2009). *Artful Creation. Learning-Tales of Arts-in-Business*. Frederiksberg, Denmark: Samfundslitteratur.

Davies, S. Macnaghten, (2010) Narratives of Mastery and Resistance: Lay Ethics of Nanotechnology. *Nanoethics* 4:141–151. Springer.

Davis, Douglas M. 1973. *Art And The Future: A History Prophecy Of The Collaboration Between Science, Technology And Art*. London: Thames and Hudson Ltd

De Saille, S. (2015). Innovating innovation policy: the emergence of 'Responsible Research and Innovation. *Journal of Responsible Innovation*, 2:2, 152–168.

Deterding, Sebastian; Khaled, Rilla; Nacke, Lennart E.; Dixon, Dan. (2011) Gamification: toward a definition. *CHI 2011*, May 7–12, 2011, Vancouver, BC, Canada.

Dixon, Steve. 2007. *Digital Performance: A History of New Media in Theatre, Dance,*

Performance Art, and Installation. Cambridge, MA: MIT Press.

Efstathiou, S. 2016. Is it Possible to Give Scientific Solutions to Grand Challenges? On the idea of Grand Challenges for life science research, *Studies in History and Philosophy of Biological and Biomedical Sciences*, Vol. 56: 48–61.

Efstathiou, S. & Mirmalek, Z. 2014. Interdisciplinarity in Action, in Montuschi, E. and Cartwright, N. (eds.) *Understanding Society: Methods, Evidence and Measurement in the Social Sciences*, 233-248. New York: Oxford University Press.

Feyerabend, Paul K. 1967. The theatre as an instrument of the criticism of ideologies. *Inquiry: An interdisciplinary journal of philosophy*, 10:1-4, 298–312.

Fisher, E. 2007. Ethnographic invention: Probing the capacity of laboratory decisions. *NanoEthics*, 1 (2):155-165.

Fisher, E. & Mahajan, R. L. 2006. Midstream modulation of nanotechnology research in an academic laboratory. Proceedings of International Mechanical Engineering Congress and Exposition, IMECE2006-14790.

Fisher, E., R. L. Mahajan & Mitcham, C. 2006 Midstream modulation of technology: Governance from within, *Bulletin of Science, Technology & Society*, 26.6, 485–496.

Friedman, B., Kahn, P., & Borning, A. 2002. Value sensitive design: Theory and methods. *University of Washington technical report*, 02-12.

Frost, Anthony and Ralph Yarrow. 2007. *Improvisation in Drama*. Basingstoke: Palgrave

MacMillan.

Geelhoed, Erik. 2013. User Requirements in Immersive Mediated Performance Spaces. *Presented at the Remote Encounters Conference,* Cardiff, April 12.

Giannachi, Gabriella. 2004. *Virtual Theatres: An Introduction.* London: Routledge.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M. (1994) *The new production of knowledge: The dynamics of science and research in contemporary societies*, London, Thousand Oaks and New

Delhi: SAGE Publications.

Giesekam, Greg. 2007. *Staging the Screen: The Use of Film and Video in Theatre*. New York: Palgrave MacMillan.

Hilton, Julian, ed. 1993. *New Directions in Theatre*. Basingstoke: The Macmillan Press.

Jackson, Shannon and Weems, Marianne. 2015. *The Builders Association: Media and Performance in Contemporary Theatre*. Cambridge: M.I.T. Press.

Jasanoff, S. (2004) Ordering knowledge, ordering society, in Jasanoff S. (ed.) *States of Knowledge: The co-production of science and social order*, Oxon and New York: Routledge.

Johnstone, Chris. 2005. *House of Games: Making Theatre from Everyday Life.* London:Nick Hern Books Limited.

Kaprow, Allan. 1993. *Essays on the Blurring of Art and Life*, edited by Jeff Kelley, California: University of California Press.

Keller, Evelyn Fox. 1983. *A Feeling for the Organism.* New York: W.H. Freeman.

Klich, Rosemary and Scheer, Edward. 2012. *Multimedia Performance*. Basingstoke:

Palgrave Macmillan.

Kupper, F. 2017. The theatrical debate: Experimenting with technologies on stage. In: van de Poel, Ibom Asveld, Lotte, Mehos, Donna C. (eds.) *New Perspectives on Technology in Society*, 80-102. Routledge.

Latimer, J. and Puig de la Bellacasa, M. 2013. Re-thinking the ethical: everyday shifts of care in biogerontology, in Priaulx, M. N. and Wrigley, A. (eds.) *Ethics, Law and Society*, Vol. V: 153–74. Surrey: Ashgate.

Latour, B. 1988. *The Pasteurization of France*. Cambridge, MA: Harvard University Press.

Latour, B. 1992. Where Are the Missing Masses?, in Wiebe E. Bijker and John Law, eds., *Shaping Technology/ Building Society: Studies in Sociotechnical Change*, 225–258. Cambridge, Mass.: MIT Press.

Lehmann, Hans-Thies. 2006. *Postdramatic Theatre.* London: Routledge.

McGonigal, Jane E. 2006. *This Might Be a Game: Ubiquitous Play and Performance at the Turn of the Twenty-First Century*. *Thesis (PhD).* Berkeley: University of California.

Macnaghten, P., Davies, S. R., & Kearnes, M. 2015. Understanding public responses to emerging technologies: a narrative approach. *Journal of Environmental Policy & Planning*,

1-19.

Miller, Arthur I. 2014. *Colliding Worlds: How Cutting-Edge Science Is Redefining Contemporary Art*. London: W. W. Norton & Company.

Montola, Markus, Jaakko Stenros, and Annika Waern. 2009. *Pervasive Games: Theory and Design.* Burlington, MA: Morgan Kaufmann Publishers.

Nicholson, Helen. 2014 (2nd ed). *Applied Drama: The Gift of Theatre.* Basingstoke: Palgrave

Macmillan.

Nydal, R., Myhr, A.I. and Myskja, B. (2015) From ethics of restriction to ethics of construction: ELSA research in Norway, *Nordic Journal of Science and Technology Studies*, vol 3. (1): 34–45.

Pérez, Elena. 2016. The Impact of Digital Media on Contemporary Performance. How Digital media Challenge Theatrical Conventions in Multimedia Theatre, telematic and pervasive performance. *Thesis (PhD).* Trondheim: Norwegian University of Science and Technology.

Polanyi, Michael. 1967. *The Tacit Dimension*. London: Routledge.

Poremba, Cindy (2007) Critical potential on the brink of the magic circle. *DiGRA '07 - Proceedings of the DiGRA international conference: Situated Play.* Vol. 4:2007. The University of Tokyo, Japan.

Prendergast, Monica and Saxton, Juliana. 2016. *Applied Theatre: International Case Studies and Challenges for Practice.* Chicago: The University Chicago Press.

Prentky, Tim and Preston Sheila. 2009. (eds) *Applied Theatre Reader.* London: Routledge.

Salvatore, S. and Valsinger, J. 2010. Between the general and the unique: Overcoming the nomothetic and idiographic opposition, *Theory and Psychology*, Vol. 20(6): 817–833.

Sheppard, Renata M., Wanmin Wu, Z. Yang, Klara Nahrstedt, Lisa Wymore, Gregory Kurillo, Ruzena Bajcsy, and Katherine Mezur. 2007. TEEVE: New Digital Options for Collaborative Dance in Geographically Distributed Tele-Immersive Spaces. *ACM Multimedia*. Augsburg, Germany, 2007.

Swierstra, T., D. Stemerding & Boenink, M. 2009. Exploring techno-moral change. The case of the obesity pill. In: P.Sollie & M.Duwell [eds] *Evaluating New Technologies*, p.119–138. Dordrecht: Springer.

Swierstra, T. 2015. Identifying the normative challenges posed by technology's 'soft' impacts. *Etikk i praksis-Nordic Journal of Applied Ethics*, *9*(1): 5–20.

Stilgoe. J, Owen, R. and Macnaghten, P. 2013. Developing a framework for responsible innovation. *Research Policy* 42, 1568–1580.

Toulmin, S. 1982. How medicine saved the life of ethics. *Perspectives in Biology and Medicine*, 25 (4): 736–750.

Tronstad, Ragnhild. 2017. Crossing Cultures: Creating a PhD Programme in Engineering, Art and Design. Berg, Arild Bohemia, Erik Buck, Lyndon Gulden, Tore Kovacevic, Ahmed Pavel, Nenad (Red.), *proceedings of E&PDE 2017 – International Conference on Engineering and Product Design Education. Building Community: Design Education for a Sustainable Future.* 1359. The Design Society.

Von Schomberg, R. 2011. Prospects for Technology Assessment in a framework of responsible research and innovation. In: T*echnikfolgen abschätzen lehren: Bildungspotenziale transdisziplinärer Methode*, P.39–61, Wiesbaden: Springer VS

Wajcman, J. 1991. *Feminism Confronts Technology,* Cambridge: Polity.

Williams, R. 2018. What do we mean by being critical?, Presentation in *Promises, Possibilities and Practices: Celebrating STS in Action*, September 28th, NTNU, Trondheim.

Windelband, W. 1904. *Geschichte und Naturwissenschaft* [History and Natural Science], Strassburg, France: Heitz & Mündel.

Winner, L. (1980) Do Artifacts have politics? *Daedalus*, Vol. 109, No. 1, Modern Technology: Problem or Opportunity? (Winter,1980), pp. 121–136

Winner, L. (1990) Engineering ethics and political imagination, in Durbin Paul (ed), *Broad and Narrow Interpretations of Philosophy of Technology*, 53–64.

Åm, H. 2018. Ethics as ritual: Smoothing over moments of dislocation in biomedicine, *Sociology of Health and Illness*, Vol xx. No xx., p. 1–15.