Ethics in Movement

Shaping and Being Shaped in Human-Drone Interaction

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ABSTRACT

How is ethics shaped by the particularities of a design? Through a detailed video analysis, we explore how ethicality is shaped in interaction between a choreographer, a performer and a choir of five drones, performing together on the opera stage. We pinpoint how movements enabled by the human-drone assemblage may limit or liberate artistic expressions vis-à-vis the norms of operatic performance. From a somaesthetics perspective on ethics, we show how the process of crafting rich experiences together with drones can deepen sensory appreciation skills, leading to an increased understanding of underlying somatic drivers and imposed norms. Somatic awareness thereby enables a richer repertoire of movements, expanding the ability to freely choose how to act, and cultivating empathy towards others. This shifts our understanding of ethics in HCI as solely about abstract rules or policies 'out there' to also concern the specifics of how technology informs or dictates movement and experience.

Author Keywords

ethics; soma design; somaesthetics; movement; drones

CCS Concepts

•Human-centered computing → HCI theory, concepts and models; Empirical studies in HCI;

INTRODUCTION

In HCI, discussions on ethics usually revolve around institutional principles and guidelines, concepts of privacy or empowerment, or rules of conduct in research. In design in general, and AI and autonomous system design in particular, ethics tends to be treated as an 'attribute' that we 'give' to a system, formulated into some sort of ethical risk management checklist [87]. This tick-box approach might lead to design processes that risk imposing limitations rather than exploring possibilities [9]. An alternative stance, which we explore here, is seeing ethics as something we perform and experience [16]. In particular, what happens if we see values as enacted through our somatic engagements, felt experiences and movements with technologies [69, 75] – as being situated in our living, sentient bodies, our *somas* [73]? Could this offer a different understanding, closer to design practice?

In the study we present here, we have explored ethicality in a designerly, practical way by studying an artistically-informed design process unfolding between a choreographer, a singer and the crafting and implementation of drones rendering the creation of a drone choir for the opera stage – The Aerial Robotic Choir (figure 1). In particular, we follow how the choreographer changes herself and the drones in order to find richer expressivity and a plethora of possible experiences. We will argue that these changes lead to self-cultivation, care of self and others, and ultimately greater freedom to choose how to act. Furthermore, we will show how the crafting of a technology, such as the drones, is where we decide on the movements our future user will be invited to perform. It is here we (as designers and engineers) either limit or expand on possible expressions, possible experiences, possible movements, and thereby shape and enact ethics.

Our work is grounded in the somaesthetic theories. Somaesthetics is, according to philosophy professor Richard Shusterman, not only an aesthetic but also an ethical project [75], where the most prominent ideal is to improve on sensory perception and aesthetic appreciation in order to live a richer and thereby better life. By attending to and learning from all of our senses, we enable not only a greater repertoire of experiences, but enhance the richness of those experiences, enabling freedom of choice – and thereby ultimately improve on our lives [22, 73, 82].

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Figure 1. Opera singer Ana Majdak performing with the drones.

Höök, Schiphorst, Khut, Loke and others (e.g. [36, 48, 53, 64, 86]) have attempted to translate what somaesthetics entail for interaction design under the umbrella term 'soma design'. Soma design requires designers to cultivate and deepen their somatic awareness as well as extracting the somaesthetic qualities and affordances in the digital and other materials forming interactive artefacts [36]. This, in turn, allows us to probe the ways in which our designs contribute to improve, expand or limit the somatic experiences of our end-users.

But what are the experiences with technology that become generative sources of heightened awareness and rich somatic experiences, while also engaging with ethics? How is ethics enacted in the practices currently being shaped around novel technologies such as autonomous systems – or drones? And how is somaesthetic appreciation and care for the body and others catered for in these soma designs?

We argue that as with any artifact, the specific design of any autonomous system – such as our choir of drones – will encourage certain movements, certain aesthetic experiences, certain practices and responses, while discouraging others [18, 23, 36]. In a sense, as designers, we leave behind a set of 'sedimented movements' embedded in the particulars of the system, movements that we invite our end-users to engage with, sometimes repeatedly over and over, such as pinching at the mobile phone interface to interact with a map, or copying from one row to the next in an Excel-sheet. While each such 'movement' might seem like an innocent, isolated act, together they move us closer to or further away from the kind of richness of experience a somaesthetic stance strives towards. The argument driving our reasoning is that it is precisely in that interplay – in those movements and adaptations of behaviours to fit with the socio-technical system – that ethics is enacted and enforced [69]. Through an ongoing engagement with technology, the way we think, feel, and engage with the world is transformed [10, 32]. As such, every design becomes an ethical project in its own right. But exactly how can we argue that a pinching gesture or dancing with a drone informs and alters how ethics is shaped and enacted?

The Aerial Robotic Choir is a choir of five drones performing, by singing and dancing, in real-time with human performers in a new opera created by Åsa Unander-Scharin and Carl Unander-Scharin, commissioned by the Croatian National Theatre in Rijeka. We present a video analysis of the choreographer's creative process and rehearsals with the singer before the first public work-in-progress performance at the opera house. Through the lens of somaesthetics, we provide an in-depth account of how ethics is enacted, manifested and cultivated between the drones, the choreographer and the performer. We aim to show how specific movements prescribed by the constitution and design of the human-drone assemblage may limit or liberate expression and experience vis-à-vis the norms of operatic performance. This shifts our understanding of ethics as solely pertaining to abstract rules or policies 'out there' to instead also concern the specifics of how technology informs or dictates movement and experience.

We are fully aware that ethics is a far more complex topic than what can be captured with one small design study. We are not aiming to provide a general account of how technology and ethics are mutually dependant, nor are we providing a full account of what a soma design perspective on ethics may bring. Instead, we see our study as a first inquiry – a first peek into Pandora's box – exploring whether a somaesthetic perspective can shed some light on how ethics is embedded in the small details of our somatic actions with autonomous systems. Whether this scales to, e.g., how ethicality is enacted at a societal level is beyond the scope of this paper.

BACKGROUND

We now turn to provide a brief overview of approaches to ethics in HCI, before attempting to outline the ideals and values that permeate somaesthetics and soma design, as well as the creation of The Aerial Robotic Choir.

Ethics and Values in HCI

When it comes to ethics and design, the conversation in HCI tends to revolve around the term values rather than ethics [70]. We find articulations such as designing for empowerment (e.g. [40, 41]), attending to issues of privacy (e.g. [7, 25]), or catering for inclusiveness and diversity (e.g. [1, 5]). Value Sensitive Design [27] was one of the first practical, 'proactive' approaches in designing for certain values, but has faced critique for attempting to define heuristics with the risk of overlooking those values situated within, or contextual to, a specific design situation [52, 59]. Worth-focused design [12] argued for the creation of 'worthwhile' experiences as a guiding ideal, emphasizing creativity and artistry over productivity and efficiency. Other approaches draw on critical perspectives to re-position technology itself as an object of reflection, such as reflective design [17, 65], or to understand values as design qualities [54]. Bardzell [5] proposes e.g. pluralism, participation and embodiment as such qualities for feminist HCI.

Most scholars agree that design processes and resulting artifacts are bearers of meanings and values, and therefore cannot be seen as neutral [43]. Still, the understanding of exactly how, why and where these values are located, where ethics is enacted and manifested, varies [26]. Some argue that technology carries the politics and intentions of the designers or companies creating them. Others accentuate designers' capacity to critique and evoke reflection among end-users and other designers on what is or should be valued. Sometimes,

these technologies are considered to embody values in material form. Another position, that we adhere to, is that ethicality is manifested in the affordances and particularities of the design, encouraging certain engagements with the self, others and world – while discouraging others [18, 23, 36, 69, 72, 75]. Ethics is shaped in use. This means that there is no one ethical design, not one definite set of predefined ethics – instead it takes form in the specifics and particularities of each design situation. Values and norms are co-constitutive between designer, user, context and technology in situ [13, 24, 43, 59, 70] – an understanding that aligns with and draws on work beyond HCI, such as feminist care and situational ethics [19, 30, 56, 60].

Somaesthetics and Ethics

Shusterman connects his somaesthetic project to ethics with the following argument:

> In proposing *Somaesthetics* as a field of theory and practice, I could appeal to ancient and non-Western traditions that cultivate the body as means of improving one's cognitive and ethical virtues as well as one's aesthetic dimension. While modernity's dominant ideology compartmentalizes and trivializes the aesthetic by sharply distinguishing it from more serious realms of knowledge and praxis (by identifying the aesthetic with mere prettiness, appearance, surface, form, play, fantasy, etc.), somaesthetics blends aesthesis, cognition, and praxis to address some of philosophy's most central aims: knowledge, self-knowledge, right action, happiness, and justice. ([72], p. 109).

Underlying his proposal lies a proposition on what it means to live a good life, here and now. By deepening our ability to aesthetically appreciate through our senses and engaging deeply and purposefully with the world around us, we can improve our human condition. In the case of the soma, values and perspectives on the world are necessarily embodied, thus, ethicality is not just an act of intellectual discussion but rather a matter of doing [61]. What appeals to us as interaction design researchers, is how the somaesthetic project is not only an analytical stance, but also a pragmatic and practical endeavour. By engaging with somaesthetics, we are provided with ideals: aiming to cultivate our own aesthetic perceptions; engaging with the poetics of interaction not overwhelming us with stimuli [33]; engaging with the pluralism of bodily constitutions [5]; caring for our own somas as well as compassionate caring for the somas of others however radically they may differ from our own; and offering design processes that are slower, more thoughtful, in harmony with the human condition [36]. In all of these processes, the ideals originate in and alter our *soma* — the living, sentient, purposive body [73, 74]. The aim is not only to improve the designer's soma, but ultimately also end-users' somas.

The emphasis on body and movement should not be mistaken for a mere motoric, instrumental activity. Movement is the basis for emotion, for experience, and even beyond that, thought processes and choices of actions [68, 74]. We are affected both kinesthetically and kinetically by what we see, hear and feel. Essentially, we are 'moved to move' [35, 38, 68]. As described by Sheets-Johnstone: "What is distinctive about thinking in movement is not that the flow of thought is kinetic, but that the thought itself is. It is motional through and through; at once spatial, temporal, dynamic" ([68], p. 421). We are receptive towards the world around us through a perceptual process of adjusting our movements and responses to another [58]. We continuously adjust to the material constraints of an environment that is dynamically changing, and includes people, animals, autonomous systems etcetera [4], in an "active process of attunement that is never fixed once and for all" ([14], p. 38). For example, Arnold and Scheutz [3] describe how their soft robots afford soft touch, which in turn entice intimacy and emotional bonding. When Höök [36, 37] wore Svanæs mechanical tail [79], she describes how curving her back and pelvis to put the tail between her legs made her feel sad and ashamed. Both examples demonstrate the generative bound between emotion, movement, cognition and expression – all connected in the body [67].

The way we make sense of emotions combines the experiential and emotional processes in our bodies and our interactions with others, colored by our learned cultural practices. As phrased by feminist scholar Grosz: our bodies are "completed by culture" [28]. Norms for how to move, feel and reason become part of ourselves, sometimes so ingrained in our habitual behaviours that we can no longer 'see' them. It is only when they are disrupted that they become discernible (and thereby possible to change). The critical awareness involved in somaesthetic reflection allows for an experiential input on what a presumed value, norm, or ideal means to the individual. This is not to say that we must always follow our gut feelings or somatic-based intuitions in our ethical judgments. It means that this somaesthetic input can help us in our decision making and that it is better to be consciously aware of norms and ideals than to let them guide us unconsciously and thus render us unable to control their influence when they mislead us.

Because the body is our "medium for having a world" ([57], p. 146), the body must also be our condition for having virtue, morality, ideals and values. By positioning the soma as the site where ethics is enacted and manifested [66, 69, 75], we need to attend to norms and ideals as subjectively experienced through our movements and bodies [36]. Loke and Schiphorst [53] call for such an 'ethics of the soma': "The role and responsibility of the designer in creating technologies and interfaces that can take account of the somatic dimension, with its ethic of care, is yet to be fully realized", p. 56-57.

At the core of ethics lies not only care for the self, but care and empathy towards others. Empathy has also become one of the core principles in HCI, contributing an 'understanding' of the intended end-users, a prerequisite for any design process. Bennett and Rosner [8] draws on feminist ethics of care [61] to put lived experience in the foreground of empathy-making when partnering with participants in the design process – a continual attunement and 'embodied' adjustment. Aligning with somaesthetic ideals and approaches in design [36, 53, 64, 78] such bodily, intersubjective engagement requires "training the senses" ([8], p. 10). Knowing how to care is habituated in the body [29]. The ability to empathize with users relies on

a foundation built on compassion towards the self – obtained and developed through self-cultivation [36]. As phrased by Loke and Schiphorst [53]: "Somatic practices explicitly frame an ethical relationship between care of self and our capacity to care for and act in the world", p. 56.

By introducing new technology into our lived environments, such as the drones we will discuss here, we might encourage alternative movements, other enactments of practices, disrupting norms, enabling novel experiences and limiting or expanding our range of experience. Drones are fascinating and evocative to us as they have a 'presence' of sorts – a body [15] that moves, makes a lot of noise, and behaves in ways that seem intelligent and alive. As our ways of understanding the world fundamentally see movement as a sign of animacy, drones appear as a sort of 'quasi-other' to us [42, 62] – seemingly with their own agency and intentionality. When we interact closely with autonomous systems such as drones, we change our behaviours and how we move around them. This happens when using them for work purposes (e.g. [46, 77]), as part of leisure activities and as social companions [6, 44, 51] or artistic performances [18, 49, 50, 55].

Soma Ethics – Beyond Right and Wrong, Good and Bad

Engaging with morality, values and norms must of course always be done relative to the individual as well as culture. Shusterman's position on norms is that: "Because there are so many different somaesthetic disciplines serving different and sometimes conflicting human purposes, which often change with changing circumstances and contexts, it is impossible to formulate a determinate and fixed set of norms for somaesthetics" ([75], p. 141). This is also true for technology design [56]. Somaesthetics does come with strong basic values, a set of normative aims, such as the belief that knowledge is better than ignorance. What knowledge is, how it is achieved and acted on differs from person to person, from culture to culture. The study detailed in this paper is set in a privileged western context, as is our (authors) position in the world as researchers and artists. But somaesthetic ethical design needs to be sensitive to the fact that different people, in different contexts or different cultures require different options for better living.

Somaesthetics, with its western origins (and practitioners) and emphasis on self-knowledge, is sometimes criticized as a selfish, individualistic project – promoting self-indulgence without caring for others or the society at large. But it is inherently intersubjective: you cannot sense yourself without sensing and being part of the environment, culture, technologies and other people. Somatic awareness can increase sensitivity to differences between subjectivities [36], thus relating personal practises "to the collective" ([60], p. 152). It is important to note that we understand the somaesthetic approach as *one* (potent) tool in the toolbox, not the only path to ethical design decisions – different ways of approaching ethics are not mutually exclusive. Rather than attempting to turn somaesthetics into a universal criteria for ethical behaviour, we are probing its generative powers in the particulars of a design, in the challenges it poses to our habits, deeply ingrained in our behaviours, and how to remedy those.

Here, we are not interested in determining whether experiences are inherently 'good' or 'bad' as that would reflect a dualistic and shallow understanding of ethics. A 'bad' experience is not unethical by default. Nor does 'bad' or 'good' hold the same values or ideals, or enactments and experiences in every situation. Our aim is not to provide guidelines or recommendations that can be generally applied to each different design process to ensure ethical design. Instead, we will engage with an overarching ideal, a somaesthetics ethics, an 'ethics of the soma', prescribing some normative aims. We will focus on:

Self-cultivation, care and self-knowledge: Better knowledge and cultivation of self through attending to, and deepening our understanding of our somatic reactions, but also care for and empathy with the self

Care and empathy towards others: Empathy with others is enabled by self-cultivation and empathy with self: without knowing your own self it is harder to know the other and vice-versa, without knowing others it is hard to make sense of yourself

Richer plethora of choice and expression: Through engaging, deeply, with the richness and aesthetics the world (including technologies) offer, richer possibilities and choices are uncovered – enabling greater freedom to choose how to act.

Expanding upon the definition of the third point, if we do not expose ourselves to a plethora of movements and experiences, our life will be limited [39, 73]. As Feldenkrais expressed it: "a limited repertory of movement is a limited repertory of experiences" [22]. But solely mindlessly entering into a range of experiences will not lead to deepened knowledge or aesthetic appreciation. We have to make choices and once we engage, we have to *attend* to what we experience and *reflect* on its meaning and consequences. Only then will it be possible to detect norms that might limit us; find movements that harm or improve on our existence; or discover the richness that might arrive through engagement with the non-habitual.

CREATING THE AERIAL ROBOTIC CHOIR

Before we dive into the analysis of how ethics is enacted in the design of the drones, let us provide a brief account of what the design aims were. The Aerial Robotic Choir is a choir of five drones performing on stage, in real-time, with human performers, as part of the novel opera ReCallas/Medea created by choreographer Åsa Unander-Scharin and composer Carl Unander-Scharin together with research engineer Vincent Trichon for the Croatian National Opera. The performance is a re-construction of the famous opera singer Maria Callas' artistry as Medea in the classical Greek tragedy with the same name. A work-in-progress showcase was held in April 2019, with the premiere and additional performances scheduled for Spring 2020. Professional opera singer Ana Majdak performs the scene together with the choreographer Åsa.

Design and Development

The drones are custom-built specifically for this project, and the programmed behaviour has been continually re-developed in as the artistic process progressed. The flying drone platforms (see figure 1), are built with four motors, propellers,

a flight controller, battery, on-board computer, 3D printed propeller-protections and frames made from glass fiber plates. A custom-built loudspeaker is placed on top of each drone. On command (sent over a WiFi-link), they play the drone's operatic phrases from locally stored music files. The loudspeakers caused very specific design challenges as they make the drones heavy, and therefore require a stronger motor, but as the noise from the drones must not overpower the singing and music in the opera, a balance between the two requirements had to be found. In the end, the drones were 3D printed and custom-built by the research engineer. An optical motion capture system keeps track of the position and rotation of all drones as well as the head and both hands of the dancer. Using this information, each drone is attracted or repulsed by (1) the human dancer (head and hands), as well as the (2) other drones and (3) the edges of the virtual stage. This combination of attraction and repulsion creates a potential field for each drone to moves within [47]. This relatively simple, physics-based model for drone motions adapts well to unexpected changes in the environment. The dancer can dynamically apply attractive and repulsive forces to the drones to control their trajectories.

Artistic Intent

As discussed above, ethics should always be seen relative to the norms of the particular context they are in as well as the particular aims of those involved. The choreographer Åsa Unander-Scharin and composer Carl Unander-Scharin's artistic aims lies in exploring encounters between interactive technology and opera. Contrary to common conception, they consider opera to be a radical performance art. The idea of exposing professional opera singers to new challenges or instruments is not radical (this has been done a lot). But introducing singing and dancing non-humans performing together with the opera singers has particular ways of disrupting and defamiliarizing habitual movements done at the opera stage [45, 84, 85], thereby exposing conventional norms and aesthetic codes that can be redefined and challenged to find novel expressions [63]. Such 'traditional' operatic norms include making the overall musical expression follow the score and the conductor - not the singer(s); the overall scenic expression follows the instructions by the stage director - not the performers; and the overall vocal idioma based on century-old bodily/vocal expressivity [83]. Norms that are put out of play when the music and stage direction is interactively produced by the whereabouts of the singer and drone performers.

Åsa explains that her artistic process rarely starts from clearly formulated expectations. Instead, these emerge from material explorations, the meeting with the technologies at hand: *"like when you are sculpting and lets the material speak back in the quest to find an expressive gestalt"*. As artists, Åsa and Carl expect to be challenged by their materials [2, 81]. It is this profound engagement that generates creative processes [54].

What is central not only to Åsa and Carl's artistic aims, but to opera as a performance art in general – and Medea in particular – is not the narrative per se, but the gestalt of the dramatic situations that the characters are exposed to. Medea is a tragedy, a genre that depicts human suffering which leads to personal downfall – not caused by 'evil' or crime but through relations with others. At the core lies fear and compassion, emotions that should be evoked in the audience, leaving them with the feeling that no more words needs to be said.

Crafting Drones, Dancer and Artistic Expressions

In a previous study, ethnographic observations and researcher's first-person experiences [18] where combined to find that the choreographer adjusts her movements according to the drones' responses, programmed abilities and restrictions, somatically attending to the drones, to their otherness, changing her movements to fit with them, and at the same time deepening her own aesthetic ability: adjusting to a 'new' soma, a socio-technical assemblage [18]. But the choreographer also asked for the drones to be changed to fit her artistic aims, asking for richer expressivity. For example, a way for the drones to perform *gestures* by making them first accelerate and then decelerate in a particular pattern was added, exhibiting, for example, a 'being thrown away'-gesture.

Here, we build on this previous work to explore how The Aerial Robotic Choir and the artistic, creative process unfolded as the choreographer continued to shape the drones' behaviours, as well as her own soma, right up to the first public performance in April 2019. We were particularly interested in what happened when the singer, Ana, who had not been part of the design process, was trained to take Åsa's place on stage. Her process of entering into this choreographer-singer-drones assemblage revealed further insights into, in particular, how empathy is shaped by our experiences. This in turn spurred our interest in how ethics is enacted.

METHOD

We followed and participated in the creation of The Aerial Robotic Choir, from development, through rehearsals, up until the first performance at the opera in Rijeka, Croatia. Our analysis will focus on a few key moments when design decisions were made that pertain to ethics as enacted in the movement between performer and autonomous system.

Data Collection

Data was collected through video recordings and fieldnotes during the course of more than a year, starting from the development process in Stockholm, Sweden, in 2018 ending with the final rehearsals at the opera house in Rijeka, Croatia in April 2019, leading up to the work-in-progress performance. Nearly 20 hours of video was collected and analysed. The choreographer and singer were also asked to comment on selected parts of the videos.

While we can learn many things from analysing video, there are valuable insights we can only acquire by engaging deeply with the felt experience of actually moving together with the drones [21, 37, 75]. Sara Eriksson (author), who is also a trained dancer, decided to dance with the drones herself after each choreographic session. Each time she took detailed notes to document her first-person experiences. Sara was also sometimes asked to enact a scene so that the choreographer could review it from an outside, audience perspective, or as an understudy for the singer in the rehearsals.

Analysis

Our analysis is inspired by the approach outlined in [75]. That is, guided by the distinctive, but related, normative aims of somaesthetics defined in *Background*: (1) self-cultivation, care and self-knowledge; (2) care and empathy towards others; and attaining a (3) richer plethora of choice and expression.

All video recordings were reviewed in full before selecting certain snippets for further analysis. The selection focuses on the moments when the choreographer Åsa Unander-Scharin's design decisions exposed a deepening somatic knowledge and appreciation of her own soma; the drones; or an empathetic engagement with singer Ana Majdak or researcher Sara Eriksson. The selected snippets were transcribed with audio- and movement notation inspired by Goodwin [10], and juxtapositioned against journal entries, fieldnotes, alongside Åsa's and Ana's comments. The data was analysed second by second [31], or line by line in the case of interviews and commentaries of the videos. The interpretations of what was happening was validated with both choreographer Åsa and singer Ana to make sure that the interpretations mirror their first-person experiences.

Below, we report on two of the snippets we analysed in detail as these illustrate some of the particulars of how ethics is enacted through the 'sedimented movements' the drones enable. As the choreographer Åsa, the singer Ana, the composer Carl and researcher Sara, are frequently mentioned, they will be referred to by their first names from here on.

SHAPING ETHICS WITH THE AERIAL ROBOTIC CHOIR

In this particular scene we discuss below, Medea (Åsa's part), dances together with The Aerial Robotic Choir, proudly presenting them as a wedding gift to Glauce (Ana's part). But it is a malicious gift to the new wife, who married Medea's former husband. Interactive musical excerpts of Medea's voice are heard from the drone speakers, evoked by the performer's movements. At first, the drones sing beautifully and are obedient to the movements of Glauce. But as the scene evolves, they become increasingly frightening and threatening, taking over the initiative from the human – which is in metaphorical correspondence with the mythological sequence of events in the story of Medea.

This scene's working title was *The Conducting Scene*, because the drones follow the movements of the human performer. The performer chooses which drone to 'pick up' by looking and pointing towards it. The drone, in turn, rises and starts to sing its operatic phrase. The drone is drawn to one of the performer's hands, but repulsed by their body so that it cannot come closer than a few centimeters. The relative distance between the dancer's head and hand determines whether the drone should come closer or move away. The drones are continuously sent new positions within the space defined by the motion capture system, that they then move towards with a slight delay, taking the shortest possible path to get to there. This set-up requires that the performer knows the logic behind the system's algorithm. For example, if the dancer wants the drone to move to a certain position in a curved shape, she has to slow down her arm movement so that the drone is sent one new position at a time together forming a curve in space. The dancer can have up to two drones up in the air at the same time: one for each hand. To land a drone, she turns her hand upside-down, pointing to the place where it should land.

Åsa and Carl wanted to explore an ambivalence where the drones seem to shift between obeying the human performer's commands and movements, and being autonomous actors driven by their own intentions. The tensions between different emotional expressions of the tragedy – the play on fear, despair and disaster and risk-taking; the drones singing and intimidating motor sounds and appearance; shifting between having the drones follow, obey or dictating the dancer's movements; all come together into an orchestrated whole where the contradictions and tensions are core.

Self-knowledge and Cultivation

Drones, choreography, music, narrative and even artistic aims were continuously revisited, altered and changed throughout the project – all dynamically *becoming* together to form an expressive scene. In order to achieve novel and interesting expressivity when moving with the drones, the choreographer Åsa had also changed her own ways of moving in the process, adjusting them according to the drones programmed restrictions and the specifics of their design. To Åsa, as a professional dancer and choreographer, this is nothing new or spectacular at all, but instead resides at the core of what it means to be an artist – whether you are moving with drones, other dancers, or improvising alone. Åsa's shaping of her own soma as a path to find novel and rich artistic expressions with the drones is essentially the basis of her self-cultivation as a performer, engaging with the tradition of dance artistry and the somatic risks that it involves. It is a performative attitude, were she is not simply engaged in some act of representation, but rather "engages fully in an act of risk involving her corporeality. It is her own sensations, and not those of a character, which are called into play" [63]. Åsa is shaping both drones and her somatic self to *"let the choreography 'live' in the drones and her own body as an ensemble"* [18], and thus becomes a mediator of the lived experience of the performance [11]. But as we will see, why, how and in what way she had changed her somatics it not always explicitly available to her – not until she sees someone else enter into the human-drone assemblage.

In the snippets we analyse here, Åsa is watching Sara and Ana perform with the drones. This in turn makes Åsa aware of the implicit adjustments she made to her own somatics to properly fit with the drones particularities, a transformation that Sara and Ana had not yet undergone. Here, Sara was interacting with the drones for the first time in a long time, and she felt really intimidated by them. In her journal, Sara describes how she felt disconnected from the drones, a feeling that made her (without success) attempt to control their every movement, making her afraid to move herself. Her movements became tense and she performed quick and abrupt arm movements with straight arms – in turn generating similar movement qualities in the drones' behaviours. Åsa reacted to Sara's incapacity to coordinate with the drones responses (figure 2): *"I saw something when you... sometimes you do like*

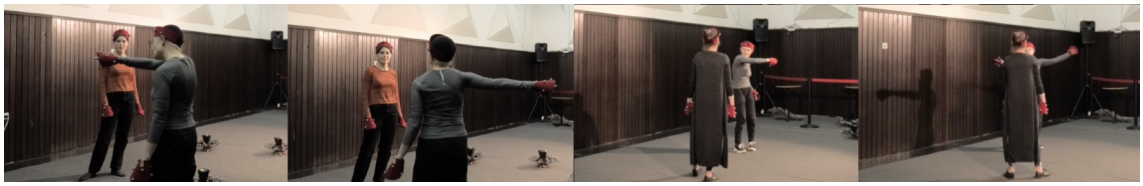

Figure 2. Left: Åsa showing Sara how to connect with the drone by slowing down her arm. Right: Åsa showing Ana how to sense the drones' movements.

this". She stretched her right arm out diagonally towards her left, and then quickly pulled it in towards her torso, to then immediately extend it out towards her right. Åsa knows that the drones' movement recognition system will not be able to follow these rapid movements properly: *"and then it takes a very long time for it to react to that"*. She wants Sara to understand that she has to wait a bit to properly 'get the attention' of the drone before she tries to move it from one location to the next by moving her arm. Furthermore, the drones are designed to, at a regular interval, 'look for' the hand of the dancer and then move from the first point to the next. If the dancer makes a movement too quickly, before the drone has 'woken up' and starts following the dancer, it will go in a straight line from its starting position to the end point of the arm movement – not exhibiting an expressive curved movement that makes it look as if it is following the hand. Åsa 'knows' this, and moves on to explain how to make the drone wake up and step by step follow her arm in a more beautiful, expressive, curved movement. To illustrate what she means, she repeats the same movement, but this time slowly and with suspension, creating a curved line with her arm rather than a straight one, then pauses her movement for a second: *"now I know that it will follow... then I can accelerate my movement but I have to feel that I... "*. She starts pulling back her arm again, showing how she knows when she is 'connected' to the drone, and then can move faster, accelerating her speed, letting go of the suspension and releasing the drone into a sweeping, curved movement.

Later, when watching Ana perform with the drones, Åsa once again came to 'see' how to adjust to the particulars of the drones. She tells Ana that if she wants to make circular movements and have the drone follow the same trajectory, she has to move her arms quite slowly. Åsa draws her right arm in a curved movement in front of her, slowly, with suspension, from one side to the other, to give Ana a sense of how to achieve a joint, curved movement with the drones. She repeats the movement again with her right arm but this time in a lighter, faster manner. She lets her left hand follow her right, in a sort of straight line, showing how the drones will respond to faster movement by taking *"the shortest path to go there, so then it will perform a straight line"*. But, as Åsa explains, these circular, curved movements are of course not the only 'right way' to move with the drones. Knowing how to achieve the joint, curved movement does not mean *"that you cannot do these straight lines"*, hinting that these should then be done with purpose, to fit with what Ana wants to express on stage. Åsa continues to highlight the importance of really sensing both your own movements and how the drones are moving to find the reciprocity that enables exploration of desired expressivity: *"you really have to feel that they are following and following"*.

This novel way of controlling the drones required acquisition of a very specific set of bodily skills for which there were no pre-existing cultural practice. The drone control skills had to be learned through exploration and adjustments of Åsa's own soma. Her skill acquisition was to a large extent tacit, the requisite knowledge of how harmonize with the drones became habituated in her body [29] – that is, the coordination, balance, speed, quality needed to not only have the drones follow her movement in a curved trajectory, but to enable that slow, suspended, joint expression. As Åsa frames it when observing Sara operating the drones: *"It is so interesting to see someone new because then I understand that it's so many things that I do every time that I haven't articulated, not even to myself"*. While articulated tacitly in her soma, in her movement, in the dance, music, and shaping of drones, it was not yet explicitly articulated.

In summary, by seeing someone else perform with the drones, Åsa attained a deeper understanding of some of the ways the drones imposed, or encouraged, certain ways of moving in order for her and the drones to achieve expressive movements together. It is possible that Åsa could have gained similar insights from watching videos of herself and the dancers perform. But, as we show here, Åsa's understanding of her own somatic adjustments came through deep engagement with the felt experience of moving together with the drones and dancers in the moment [21, 37, 75]. This somatic awareness – whether tacit or explicitly articulated – is what enables self-cultivation and self-knowledge [73]. For Sara, getting Åsa's help to 'know' where the real control over the drones could be exerted, leads not only to self-cultivation but also helped her see how she could care for her own safety.

Beyond *self-cultivation, care* and *self-knowledge*, a deeper somatic understanding is crucial to uncover both restricting norms and (thereby) novel movement possibilities [72]. Through Åsa's increasing somaesthetic awareness of what is disabled/enabled by the human-drone assemblage, she also opens for designerly imaginations of what 'could be' (within the limits of what drone technology affords). In fact, the whole curved movement of the drones came out of earlier design work that made it clear that the drone had to approximate its movements to a curved trajectory in order to be expressive towards the audience of the opera.

Care and Empathy towards Others (Somas and Drones)

Åsa's deliberate adjustments of her self and her work towards deepened somaesthetic appreciation of nuances and possible expressions with the drones, increases her care not only of her own soma in relation to the drones, but also her ability to care for others. In the account of the snippets above we saw an illustration of Åsa's intersubjective attunement to Sara and Ana, and the drones. The soma is always essentially existing in relationship to its environment, and therefore, we can never feel the soma alone without feeling the environment, including other bodies or drones. As such, proper care and cultivation of the self necessarily implies concern for others – testifying to the essentially ethical dimension of self-cultivation and the transactional nature of the self [69, 73, 74, 71].

In the account above, there is an obvious relationship between Åsa and Ana and Sara. But there is also something evocative about the drones and how they spur a bodily resonance of sorts. Åsa, Ana and Sara become 'moved' by watching and interacting with the drones. Sara is scared of them as she feels they are out of control, occasionally getting too close. Her whole body stiffens. Åsa has found a way to feel *connected* to them, a form of reciprocity, even if she is not fully controlling them. In Åsa's self-cultivation as a performer and learning how to manage the drones, there is a self-cultivation that includes concern for the drones: that they do not get damaged or fly into the audience, damaging them.

Underlying the care for the drones and the performer, we find not only cognitive reasoning (crashing a drone would be bad), but a real emotional bond. For example, in the video snippet above (figure 2), Åsa first describes to Ana how the system works technically , how the drones *"are always a little bit delayed..."*, explaining why slower movements and patience with respect to the drones' response are required to enable coordination. She continues to explain that achieving a curved trajectory is not a matter of simply moving her arms through space from one point to the other, but requires that you attend to the movement, *feeling* the curve, and *feeling* that the drones follow, in order to establish a connection: *"If I want it to be a curve, I need to feel that it [the drone] is following my hand and doing it, the curve"*. She twists her body to her left, stretches both arms out in the same direction – one representing her and the other representing the drone – with some space between them, moving them and her body slowly in a curved shape.

The dancer has to care both for herself and for the drones in terms of managing to keep the constellation of her movement and their movement in a dynamic harmony. Åsa is trying to capture not only the joy of finding a connection and having the drones follow your movement – the cognitive 'know-how' – but the sensuous pleasure of the coordinated movement itself [75], to *feel* the suspension in anticipating the drones and extending the arms and body through a curved shape that continues in the drone's 'body'. Åsa is trying to capture the intersubjective connection that is both *felt* by the performer and evocative to the audience. This sought expressivity points to the connection between the performative, experiential and representative dimensions of somaesthetics [73, 74, 71]: somatic knowing; *feeling* 'pleasure' in the movement itself; as well as 'looking' good.

The enjoyment of sensing, attending to and exploring the movement itself contribute to further somaesthetic attention and improved awareness, while at the same time reassuring the performer that the movement is understood and is performed in a manner that meets the aesthetic aims required by the scene [75]. Not being able to do so, as for Sara and Ana in this case, does not testify to a lack of effort, attention or will, neither an 'evil' unwilling, but rather a lack of efficacy to which Åsa is now offering a shortcut to mend by guiding Sara and Ana towards better learning and thereby improving their somaesthetic expressivity. Their 'failure' to meet these norms are quite easily detectable, especially to Åsa who has trained her own somatic sensibility while bettering her own self-knowledge. Åsa uses her skills and experiential awareness to deepen the aesthetic qualities of the performers, and thereby improves the performance. Trough movement, she is attempting to convey to Ana and Sara what the 'rules' are, how to understand the drones and find ways of moving together with them. It is not about control, but care – about unlocking an open-ended potential to explore their specific dancer-drone movement possibilities [68]. She is providing a path for Sara and Ana to discover their own ways of being expressive with the drones.

There is of course a possible tension between complying with Åsa's visions and instructions, versus engaging deeply with your own experience and finding the expressions that originate in your own soma as moved by, and moving with, the drones. Different performers will be bringing different somas to the stage. But beyond those somatic differences, simply imitating Åsa's movements detached from somaesthetic attention will not necessarily lead to improved somaesthetic awareness, nor an interesting expression on stage.

In summary, Åsa's self-knowledge (as a choreographer) allows her to emphatically attend to both the performer(s) and the drones as well as the audience. It is the prerequisite of care and empathy towards others [69, 74]. Her self-knowledge is challenged by the behaviours of the drones – leading to learning and adaptation, and in turn to empathy.

Expanding (or Limiting) the Repertoire of Expressions

Through the interaction with the drones, Åsa aims not only to care for herself (and the performer who will take her role), the audience and the drones. Perhaps even more importantly, she aims for co-expressivity with the drones. She, for example, gets very excited when the drones can come really close to her body as this adds a dramatic experience to their joint movements. She also gets excited when she learns how to become connected to a drone, dragging it into a curve following her hand, rather than a straight line, as to her the curve is more expressive. About these situations, Åsa says that she does not want the drone to be a 'slave', perfectly adjusted to her movements. She needs *friction* to find artistic expressions that goes beyond some boring synchronous behaviour where the drones simply follow her slightest command. She was modifying her body movements (and those of the drones) in

coordination with the drones – respecting them as being other than herself. In dancing with them, she strives to feel them as an individual other (or *"alien"*, as Åsa once described it) outside her own body though closely in contact and harmony with it – a bodily resonance, with a sense of the two feeding off each other's movements and responses. Together with the drones, she can be more expressive, in different ways, beyond what she could be without them. This is where Åsa can arrive at a richer plethora of expressions, of possible acts, leading in turn to an artistic freedom of choice. It can be seen clearly in the snippet where she tells Ana that she can choose to create a straight trajectory for the drone, or she can make it follow a curve depending on what she wants to express. A space of possible performer-drone expressions has been opened. This space did not come about without effort. Initially, the drones limited expression more than they added. The drones' fragile materiality and the initial (in)stability of the system slowed down the creative process. A sound cable melted and dripped hot plastic onto the engine; a battery got drained and needed replacing; or the drones would lose contact with the motion capture system and continue their trajectory beyond the invisible walls of the system and hit the actual wall before breaking into a million pieces. The fear for safety and possible embarrassment of having the drone crash when you were performing with them transformed Åsa's, Ana's and Sara's expressions in a delimiting way. Sara describes how she sometimes paid careful attention to the movement of her arms and wrists, especially when there was a greater distance between the drone and herself, so that she would not direct the drones too close to the boundaries defined by the motion capture system; or how she tried to avoid sending a drone off into oscillation that would, in a best case scenario, disturb her connection with the drone, or, in worst case, set them off on a track towards an inevitable crash. When the fear took over, she avoided going too far out on the edge of the virtual stage and instead kept to the center. While the engineer who built them reassured the performers that the drones would not crash into you, the wall or anyone else, that did not help much when you could not *feel* that they were safe.

The drones had to be changed, making it possible for the dancer to adjust to the drones to be able to take full advantage of them, letting the dancer make the dance come to life. And so the drones (and safety systems) were changed – many times. And along with them, so was the narrative in the opera. Originally, Åsa and Carl might have imagined that the drones would exhibit more autonomy. With more autonomy, they could have acted as the choir in a classical Greek drama, commenting and interfering with the human characters throughout the opera performance. But as the process of creating the drone-singers progressed, it was clear that they would not be autonomous in the sense Åsa and Carl had imagined: their spacial capacity for action was limited, and they lacked inner, first-person intentionality and perspective and were instead controlled by the motion capture system. As the drones revealed their 'personality' traits, Carl and Åsa therefore crafted them into a (frightening) gift from Medea to Glauce instead. There was a risk here that the drones could have imposed nothing but limitations in terms of possible movements and expressions, which would have caused the whole project to fail. But Carl and Åsa found interesting ways to expand the expressivity within the frames of the material affordances and what these drones showed themselves to become, and to continue to push and explore those boundaries [20].

Even though Åsa and Carl might have imagined a whole range of other expressions that the drones should have been able to perform, they were intrigued by their non-intentional behaviours, their bulky, noisy appearance, and how these behaviours rendered interesting stage personalities. They could be programmed to exhibit a back-and-forth behaviour from obeying and following the performer, to becoming frightening through attacking. Based on these basic behaviours, the scene and interactions were crafted. The particular affordances of these drones encouraged expressions of despair, intimidation, or disaster. For example, when the drones fly, the overwhelming sound from the motors reminded Åsa and Carl of hovering rescue helicopters, entering the scene of an accident. Arriving at a more realistic and still expressive scene was achieved not only by the engineer changing the security system, or how Carl and Åsa learnt how to understand and interact with the drones' *'otherness'* and particularities. Throughout the process, the design of the drones and their behaviours were carefully crafted. For example, at first their speed was too even which made them look less expressive. They were therefore reprogrammed to first accelerate and then decelerate when moving from one point to the next – simulating the increasing speed and tension of a body that asserts itself to initiate a movement or the decreasing speed letting that movement go [84]. By experimenting with different velocities and dynamics, an experience of movement as initiated from the mechanical bodies of the drones themselves could be crafted. To the onlooker, this gave them a more lively behaviour, a sense of gesturing and possessing intentionality.

As we have discussed already, it was not only the drones, the narrative and choreography that were shaped in this process – Åsa also adjusted her own body movements and somatic expressions to fit with theirs. Both the drones and Åsa were 'designed' to enable novel joint movement expressions. Through these changes, Åsa finally reached a point where she felt a connection with the drones. She describes it as *"a line between her hand and the drone"* [18] – an immediate, perceptual understanding of the drones that allowed her to adjust her movements and respond to theirs, in the moment. For Åsa, it was spurring an urge to explore the scary-exciting sensations of having the intimidating drones coming close, following them as they followed her – creating a choreography based on what these explorations enabled. Mastery of the drones allowed her to explore how best to utilize them to create the aesthetic expression she is after. This is to a large extent a tacit process of kinesthetic creativity [34, 80]. Sheets-Johnstone speaks of this process as improvisation to handle an "ever-changing kinetic world of possibilities" ([68], p. 142) where movement and exploration happens simultaneously.

Freedom of choice in how to act and move should not be confused with what is pleasant, unpleasant, good or evil. Sometimes the path to expressivity and choice goes through the

unpleasant, the scary. Åsa is a professional dancer and choreographer. She finds these adjustments of her movements to be the rich soil from which her creative, somatic practice arises. To feed her creativity, she needs the otherness of the drones, their scary behaviour and the resistance they offer. Through her movements she enacts the drama of the opera — fear, resistance, despair and disaster. As such, Åsa's somaesthetic repertory is deepened, thriving off what the drones afford, their expressive potential in the meeting with her body and movements. Åsa says that *"there is this balancing act where the safety makes everything uncertain... you have to really push that boundary too see where it takes you"*. This is where the ethical self-cultivation is enacted: enabling strong expressivity and experience.

There is of course more work that could be done with the drones to make them even more expressive. But this should not be taken to mean that we should strive for some sort of pleasurable perfection. Instead, uncomfortable interactions and frictions are sometimes necessary to spur artistic expressions and creative processes [45, 85]. Ethical self-cultivation is not care for the self in the sense of worrying that you will get hurt or staying in your comfort zone. And more expressivity does not automatically equate to 'better' ethics. But in the case of the drones, and as an artist, choreographer and performer, Åsa needs to explore the limits in order to become expressive. Her desire for greater expressiveness is her self-cultivation as a performer, implying a concern for the tradition of dance artistry and the somatic risks involved [11, 63]. Sometimes this means exploring the scary, the dangerous. In that sense, through pain, fear or probing limits, we can come to know what is possible [76].

In summary, by attending to our experiences, by heightening our sensory sensibilities and better our somatic capacities we expand our repertoire of possible experiences and movements, thus expanding on our ability to choose how to act and move. The soma (with our ability to move it and move with it) is our most basic site and experience of choice; better somatic capacities (cognitive as well as performative) expand our possibilities of choice. Technologies may spur such explorations or delimit them. The soma is where we can both realize the ethical ideals of care for the self and care for others, but it arrives with the soma's interaction with the environment – including any technologies we put in it.

CONCLUSION – SOMA ETHICS ENACTED

We have argued that depending on what kinds of movements some particular piece of technology offers, it will in turn not only shape our repertory of movements and experiences, but ultimately how ethics in enabled and enacted. As Åsa dances with the drones, she changes herself: to what the drones can and cannot do; to what is safe; to what is expressive; and to the artistic intentions of the scene. Åsa also changes the drones – within the limits of what these drones may afford – to arrive at the expressivity the stage requires. It is in this process of crafting a technology that we decide what movements our future user will be invited to perform together with the technology. It is here we (as designers and engineers) either limit or expand on possible expressions, experiences, and movements. And it is in these detailed decisions that ethics is shaped, over time becoming ingrained and habitual, enacted in the (in our case) human-drone assemblage.

The idea of ethics as something dynamic and emergent means that we can contribute to its shaping, even though we cannot know in advance exactly how users will engage with the systems we design. As design shapes us, and as current designs often fail to shape us in the direction we wish to grow as individuals or communities, we have to attend to the ethicality of design in the making and doings *in situ*. Ethics is something we experience, negotiate and practice when we are in movement with others and our environment.

Soma ethics in performance projects is to a large extent dependant on the attitude or orientation one brings to a project. This orientation is for the most part implicit, and manifests itself as one's inclination to behave in a certain way. It is thus habitual. It is not the habit of specific actions and behaviours, but the habit of how to relate to self, body, others, objects and environment. This attitude/orientation is both cultural and personal. Being habitual and implicit does not mean that it can not be made explicit and changed, but simply talking about one's 'soma ethics' does not necessarily change it, as with anything deeply rooted in culture, habitual movement, person or collective. As educators of future designers we have the opportunity, and maybe the duty, to embody a caring orientation towards ourself, our soma, our students, and the material world. Soma ethics is best learned and cultivated through practice [71]. We are grateful that Åsa, through her example in her role as choreographer, has taught us the basic elements of a caring, empathetic and expressive soma ethics in design.

With this analysis, we have probed somaesthetics as a generative approach to ethics in design – seeking its relevance to small and big design decisions. But what happens when we turn our attention to widespread use of drones or mobile phones, compared to challenging norms of the opera? How can the soma design perspective on ethics transcend beyond this particular, artistic context? Does it scale to handle issues of power, privacy and inequality at a societal level? Scaling effects are likely to introduce ethical issues that do not appear in one singular use situation. Future work needs to address these societal-level questions by continuing to probe the limits and opportunities of somaesthetic ethics in interaction design.

To conclude, our proposition here is that through engagement with a somaesthetics perspective on ethics in design [36], we can put the felt experience and enactment of ethics at the foreground. We can probe which movements lead to deepened somatic awareness; social awareness of others in the environment and how they are affected by the drone-human assemblage; enactments of bodily freedoms rather than limitations; and increased aesthetic experience and expression.

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