Dancing With Drones

Crafting Novel Artistic Expressions Through Intercorporeality

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ABSTRACT

Movement-based interactions are gaining traction, requiring a better understanding of how such expressions are shaped by designers. Through an analysis of an artistic process aimed to deliver a commissioned opera where custom-built drones are performing on stage alongside human performers, we observed the importance of achieving an *intercorporeal* understanding to shape body-based emotional expressivity. Our analysis reveals how the choreographer moves herself to: (1) imitate and feel the affordances and expressivity of the drones' 'otherness' through her own bodily experience; (2) communicate to the engineer of the team how she wants to alter the drones' behaviors to be more expressive; (3) enact and interactively alter her choreography. Through months of intense development and creative work, such an intercorporeal understanding was achieved by carefully crafting the drones' behaviors, but also by the choreographer adjusting her own somatics and expressions. The choreography arose as a result of the expressivity they enabled together.

CCS CONCEPTS

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

KEYWORDS

movement-based interaction, intercorporeality

1 INTRODUCTION

Movement-based interactions are notoriously difficult to design. To inform the design of these interactions, some argue that new forms of engagements, such as first-person felt perspectives, are needed [16]. But if we employ a first-person perspective in the design process, how can design intentions and experiences be shared? And what concepts and theories can we use to unpack the felt dimension of movement enabling novel interactions to be crafted?

We engaged in an artistic creative process aiming at bringing five drones onto an opera stage to perform alongside a human performer. The choreography, music and the custom-built drones were created together – the design of one informing the others. The resulting drones are equipped with speakers so that they can sing, and sensors to provide them with perceptual capabilities that allows them to respond to and improvise with the human performer in real-time. What is particularly interesting when designing with autonomous systems, is that they will not only respond to their physical environment, but through their movements and bodily presence, they also express their own intentionality and agency – exhibiting a *corporeality* of sorts. In the project at hand, the choreographer, using her movement expertise, kinesthetically engaged with the drones' corporeality, their morphology, to find and design their movements, ultimately aiming to generate novel aesthetic and affective experiences. In fact, as we shall see below, not only the choreography, music and drones were created in this process, but the choreographer also changed her somatic self to enable a rich dialogue with

the drones and to *"let the choreography 'live' in the drones and her own body as an ensemble"* as she expressed it.

We present a video-based analysis of the choreographer's creative process, unfolding over several months. As a theoretical lens to understand the interactions between the choreographer, engineer, drones and the ensemble choreography, we found concepts from somaesthetic- and postphenomenological theories informative. Somaesthetic theories and concepts in *soma design* [15] helped us see and understand the 'somatics' and subjective, first-person, felt experiences of the choreographer. Postphenomenology, in particular the *alterity relations* concept [18], helped us understand how the choreographer related to the 'otherness' of the drones' morphology. *Intercorporeality*, finally, is a concept introduced by Merleau-Ponty [34] that foregrounds the social nature of the body and at the same time the bodily nature of our social relationships. For our choreographer and the five drones in her ensemble, intercorporeality was achieved through the process of designing and altering the behaviors of the drones; repeatedly dancing with the drones; but also through imitating their behavior by moving as they do, in order to feel what they might express – exploring and exploiting their expressive affordances.

Let us start by providing a short background to these theoretical concepts and some of the HCI work on designing with movement in artistic settings, before we turn to our study.

2 BACKGROUND

Somaesthetics and Soma Design

In most HCI-work, the body, or as we would prefer to name it, the *soma*, is missing from the analysis. If there is a body at all, it is most often seen as a form of machinery with interesting and strange behaviors that a designer should know of in order to not harm the body, keep it healthy, or as an 'arena' to play tricks on in order to lure the user into some particular experience. In contrast, with a somaesthetic perspective in design (e.g. [17, 42]) the soma is put at the core: a bodily subjectivity, a living, purposive, sentient, perceptive body, in which movement, body, emotion, cognition, perception, and sociality are tightly interlinked [48]. The idea of a soma bridges the mind-body divide, explaining how movement and emotions share a generative and expressive relationship [44], arising as a response to our dynamic environment encompassing objects as well as other 'bodies' [22]. By putting together the concept soma with aesthetics into *somaesthetics*, Shusterman is drawing our attention to how aesthetics cannot be reduced solely to visual aesthetics, but instead entails a learning process that resides with all our senses [47]. Through a deep engagement with our senses, we can enrich our experiences, become more fully aware of our selves, our

experiences, of others, and ultimately improve on our lives. Ultimately, this may lead to what Thoreau [54] speaks of as an awakening from the mindless, joyless engagements that result from a lack of attention to the senses.

As discussed by Höök [15], a *soma design* process requires engaging not only with your own soma, but also with (digital) materials to extract and make novel aesthetic expressions possible: "*we must never forget that the digital and technological materials are only half of our design material: the other half consists of our own somas and those of our users. Our materials are, in fact, sociodigital.*", (p. 127). In the case at hand, the socio-digital material consists of: drones; dancer; audience; music; and the dynamically unfolding interplay between them. As we will see below, they are all exposed to change throughout the creative process.

Postphenomenology

Postphenomenology is gaining traction in HCI [5, 11, 62, 63]. While phenomenology studies the relation between human and the world to find what it means to be human, postphenomenology looks to the relations between human, technology and the world. By understanding technologies as non-neutral mediators, postphenomenology differs from other prevailing theories that puts human agency at the core [18, 41, 61]. Postphenomenology sees subjectivity and objectivity as co-constructed through the bodily-perceptual relations that arise between humans and technology – a view that rhymes with the soma design theories.

Ihde proposes four main ways technology mediates human relations: as embodiment; as a hermeneutic relation; as an alterity; or as residing in the background [18]. *Embodiment* relations are characterized by a symbiosis of a person and a technology, such as eyeglasses. In *hermeneutic* relations, a technology reveals some aspect of the world to us, such as with a thermometer. *Background* relations reside in the periphery of human attention, such as the heating system of our home. Here we will focus on the *alterity* relationship that, according to Ihde, occurs in situations where the technology itself is in focus and the rest of the world is only a distant referent. The technological artifact becomes the 'other', as, for example, when interacting with intelligent robots.

Intercorporeality

The concept *intercorporeality* is how Merleau-Ponty [34] transformed the problem of how it is possible for one mind to fully know another. Rather than seeing consciousness as a private inner state, Merleau-Ponty sees our whole beings as existing in the world. To see the other is not to have an inner representation of her. It is to "be with her", a 'carnal intersubjectivity'. It foregrounds the social nature of the body and at the same time the bodily nature of our social relationships. Thoughts, feelings and intentions are not only

accessible to one subject, but are manifested in what we say, do, express facially, through movement – through our corporal beings. Intercorporeality thus becomes a perceptual process.

In a human-human relationship, intercorporeality builds on a deep premordial bond. In the case of human-drone intercorporeality, a kinesthetic awareness must be achieved as the drone possess a different corporeality.

HCI, the Arts and Movement-based Design

In the AI/HCI intersection, interest is growing in autonomous agents with the ability to take own initiatives and thereby foster co-creative exchanges with artists and designers [12, 27]. In performing arts, interactive technologies and robots have already entered the stage alongside human performers or audience members (e.g. [4, 20, 26, 38, 40, 51, 57, 58]). Drones are no exception, co-performing with dancers as swarms [31], partners [25], or pixel-formations in large-scale performances [19]. According to Auslander [2], when interactive systems perform autonomously or semi-autonomously in real-time they may be perceived as coming 'alive', exhibiting their own agency and intentions. Performers as well as audience will attribute intentionality to them [39]. The interaction becomes a dialogue, a negotiation, between the technologies and human performers, a process that can be creatively generative for dancers and choreographers [3, 36]. Most of those studies however, with the exception of [1], are post-analysis studies and do not tell us how or when such generative interactions arise.

When performers encounter interactive artworks, a process takes place in which the performer (or even the audience) adjusts their bodily expression and movement to the technologies. Designers and artist co-develop with their technologies throughout the design process [53]. A mistake we might make is to assume that it is only the frictionless (embodied) interactions that will render interesting expressions to the designer/artist. Let us provide a few examples from the art- and HCI world where it is the contrary – that is an uneasy, tense, relationship between performer and technology – that generates interesting expressions. Karpashevich and colleagues [21] designed an interactive, restrictive ballet costume that when worn, by limiting her movements, requires the dancer to adjust to her new soma, a process that while unpleasant also became generative. In their study, they found that the character in the ballet was, in a sense, embedded in the awkwardness of wearing the costume. Wilde [64] played with awkward movements as a path to kinesthetic discovery and playfulness with hipDisk, two disks worn as a skirt generating music when hips and torso move horizontally, making the wearer "look silly". Šimbelis and colleagues [66] describe how the audience members experienced frustration and confusion as they tried to control the art piece

Metaphone – a system that generates paintings from the performer's bio-sensor data and movements – only to learn they could not control it. Instead the performer had to find what was in-between control and surrender. With a more traditional HCI perspective, frustration and confusion are usability issues that should be fixed. Artists however, expect to be challenged by their materials [1, 52]. In fact, designers and artists often spend substantial time choosing, engaging with and arranging materials (old and new) in order to spur creative processes [30].

3 CREATING THE AERIAL ROBOTIC CHOIR

Our research group has a long-standing interest when it comes to movement-based design. We were presented with a unique opportunity to engage in a creative process aimed to deliver a commissioned opera performance. Based on their prior work on encounters between opera and technology, Åsa and Carl Unander-Scharin had been commissioned to create a novel opera named ReCallas/Medea. Their aim was to revisit and reconstruct the artistry of opera singer Maria Callas through a blended performance thriving off the combination of the architecture of the theatrical space (the (neo)baroque opera house in Rijeka, Croatia), various robots and other interactive technologies, a novel choreography, video, newly composed music – all coming together in a live performance. The premiere is planned for Spring 2019. Åsa and Carl's position, perhaps contrary to common belief, is that opera – in its exceptional cases and moments – is a radical performance art [56]. By placing technologies such as robots or drones on stage, they push themselves to create novel expressions and disrupt the power hierarchies of the traditional opera.
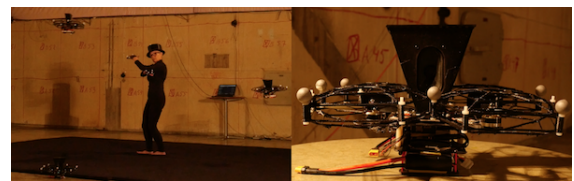

Figure 1: *Left*: **Åsa performing with the drones.** *Right*: **Drone from the front, with loudspeakers and markers.**

The drones (see figure 1) are custom-built specifically for this project using 3D-printing and special software. The frame is made from thin glass fiber plates, and the propellers have 3D-printed protection. Each drone has a custom-built loudspeaker on which music files, stored in the on-board computer, can be played, using commands sent over wifi link to the drone. The design has been guided by the (partly conflicting) requirements of: (1) as little motor sound as possible (low weight); (2) as loud music as possible (increasing weight); (3) and enough motor power to enable the agility needed to render a life-like impression. An optical motion

capture system keeps track of the full position and rotation of all drones as well as the head and two hands of the dancer. Using this information, the system emulates a biology-inspired behavior where each drone is attracted to certain points, and are repulsed by other points. This combination of attraction and repulsion creates a potential field for each drone according to which it moves [23]. The dancer can thus dynamically apply attractive and repulsive forces to the drones to control their trajectories. A more exhaustive description of the drones and their control system can be found in [55].

4 OUR STUDY

This study is centered around choreographer Åsa Unander-Scharin as she interacts with the drone(s) to invent and device expressive movement sequences for two scenes in the opera performance, in collaboration with composer Carl Unander-Scharin and research engineer Vincent Trichon. Åsa is a professional dancer and choreographer who have created more than 30 scenic performances that involves robotics and interactive music technologies. Her artistic interest lies in exploring novel expressions in dance and opera, and how technological bodies can elicit emotional responses in the audience. Sara Eriksson, who collected the data, was asked on occasion to contribute through acting with the drones so that Åsa could see the scene from the outside. As Åsa, Carl, Vincent and Sara are mentioned frequently they will be referred to by their first name from here on.

Data collection

Data was collected through a combination of participant observations and first-person experiences during the course of 2 months. Observations of interactions between Åsa, Vincent, Carl and the drones were conducted in 8 sessions lasting between 1-2 hours each, documented by video recordings and field notes. The observations took place in *Reaktorhallen* at KTH: a large, underground venue that used to be an actual nuclear reactor hall.

As we shall see below, to properly analyze the collected data, it was not enough to watch Åsa, Vincent and the drones. Sara, who is also a trained dancer, decided to experience the different scenes herself. Only then was it possible for her to understand some of Åsa's statements, expressions and movements [6, 16, 43]. After each session where Åsa and Vincent tried the drones, Sara enacted the same scene and then tried to articulate her bodily experiences as richly as she could in her notes.

Analysis

The collected data was analyzed using the concepts and theories outlined in the background: soma [15], somaesthetics [47, 48], intercorporeality [34], and human-technology relations [18, 41]. The analysis focused on questions such as how the performer/choreographer encounter the drones, what movement actions that are enabled and restricted by the drones and how emotional expressions are shaped and formed in and through movement.

All video recordings, close to 10 hours of video, were transcribed in full, with audio and movement notation inspired by Goodwin [10]. Certain snippets of video were selected for further analysis. The snippets that revealed the most interesting processes underlying Åsa's creative, artistic process were events in which Åsa expressed herself through movement when she was either 1) inspired by the drones' own movements or 2) wanted to alter the drones' behaviors to enhance or change their expressions. These moments reflect back on the relationship between movement and emotion as generative and expressive at the same time (as discussed by, amongst others, Sheets-Johnstone [44]). Specific attention was paid to how Åsa used her body-in-motion to communicate in these situations, as it is difficult, sometimes impossible, to express certain bodily sensations, experiences and knowledge in words.

Coding procedure. Åsa's comments on selected video snippets were juxtaposed with journal entries, transcriptions and field notes that corresponded to the same event, alongside Sara's notes. The data was analyzed following a grounded theory approach [49], through open- axial- and selective coding. This approach enabled us identify unexpected patterns emerging from the data, such as how the drone(s) enable novel, bodily experiences and expressions that are challenging to put into words. The selected video snippets were first analyzed by Sara, and then by a second, independent researcher, Kristina Höök. First, the selected snippets, journal extracts and comments were analyzed second by second, or line by line, individually by each researcher, to then proceed coding collaboratively. In selective coding, we selected dimensions that respond to situations that evoke emotional responses or spurred creative processes in the performer/choreographer (e.g. 'movement as meaning-making'). After the analytical procedure of coding and categorizing the data, we validated the results with Åsa, making sure that we captured her experience without any misunderstandings or gaps.

5 THE PROCESS OF CRAFTING EXPRESSION

Our analysis starts from the two scenes that grew out of a combination of, on the one hand, Åsa and Carl's vision for what the drones should be able to do and, on the other hand, the realities of what the drones would be able to do. Our four accounts below focus on moments of creativity unfolding between Åsa, Vincent and the drones. The first account belongs to a scene that Åsa refers to as *The Conducting Scene*, while the others belong to *The Falling Scene*.
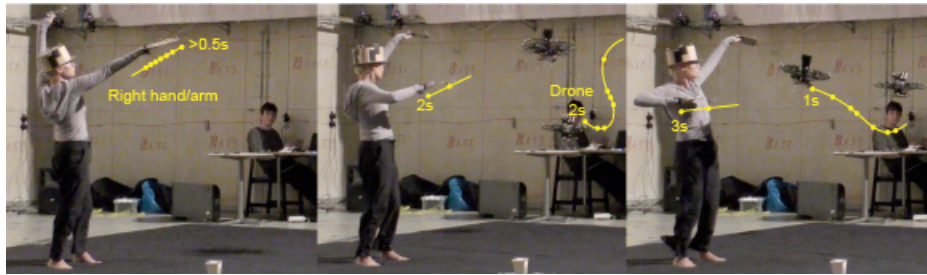
Figure 2: Åsa is extending her arm to make the drone go far away from her, to then pull it in close to her body.

Scene 1. *The Conducting Scene*

In *The Conducting Scene*, the five drones follow the movements of a human performer. The performer chooses which drone to 'pick up'. The drone then in turn rises and starts to sing its operatic phrase. A drone is connected to, or rather drawn to, one of the performer's hands, but will never 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. The drones will always take the shortest path to get to that position. There is also a slight delay until the drone receives a new position and responds to the command. Thus, this set-up requires that the performer knows how the algorithm works. 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. Otherwise, the drone will take the shortest path between the starting and ending position. The dancer can have up to two drones in the air at the same time: one for each hand. To land the drones, she turns her hand upside-down, pointing to the place where it should land.

Building a Connection, Crafting a Common Rhythm

Åsa was looking to feel a connection with the drones as they moved together with her. She describes the connection she is seeking as *"a line between your hand and the drone"*. To establish this connection, she experiences her interaction with the drone as a *"constant sensing… that enables me to understand what I can do and when I can do it when I have that connection"*. When it is possible to achieve a sense of synchrony between her movement and the drone's, her experience is that the drone offers a sort of resistance as it cannot follow instantly but will, instead, exhibit a slight delay both in terms of initiating their joint movement but also to move from one position to the next. To engage with this movement, Åsa has to adjust and fine-tune her body movements too. She has to explore and feel, through movement, to know what

she and the drone can and cannot do together: *"They follow me but I also follow. Just like when you play an instrument 'okay this is how it sounds now'. It's not control but it's beyond the idea of control somehow"*. This reciprocity between Åsa and the drones' technological bodies finally came to a state where she could adjust and coordinate her responses in a sort of pre-reflective state. This intercorporeal connection is not something that just arose 'naturally'. It was a learning process that took time. Åsa had to learn to understand the drones' 'otherness' and ability to follow her, a process that required kinesthetic engagement.

But it was not only Åsa that had to change her movements, the drones themselves had to be changed too. For example, at first, the drones responded with too much delay (a consequence of the initial safety system that could be relaxed after some time). Their movement had to be programmed with the right speed and sensor sensitivity so that a synchronized rhythm could be achieved. Initially, Åsa felt that there was not enough difference in the drone's distance from her hand when she pulled it in close to her body compared to when she stretched her arm out. She wanted the feeling of pulling something close, and then sending it away with a clear push. Vincent had to expand the distance so that when the performer's hand was placed close to her body, the drone came closer to not just the body but also to the hand, and when the arm was fully stretched out from the body, the drone would go further away. In the particular moment we are analyzing here, for the first time, Åsa felt that she could 'throw away' a drone by making a distinct 'throwing' or 'pushing' gesture. In this video snippet (figure 2), Åsa is controlling two drones. She pulls her right arm, controlling the drone at the far-right corner of the photo, from its fully outstretched position, to being close to her torso. The drone in turn travels across the room with a velocity that is dynamic and changing according to Åsa's movement and the drone approached her and came really, really close. She got very excited that it came so close. She felt that the system let her find a rhythm that felt good to her and corresponded to the gesture she was performing. She felt more *connected* to the drones as she could direct them in real-time and they responded accurately. In Sara's notes

from her own experience of repeating Åsa's movements, she describes the experience as scary and exciting at the same time. It was intimate, fun, yet there is something scary about the inanimate technological body. As it moves strangely and looks like a alien being with its oddly formed mouth that is constantly open and tiny eyes (the loudspeaker and the screws that holds it in place), it is not clear what its intentions are. Our human response is one of fear when it comes too close. To Åsa, it was spurring an urge to explore ways of moving her body with the rhythms of the 'coming-close' versus 'being repelled' behavior, creating a choreography based on what these explorations enabled.

When you achieve synchrony, when you feel that connection to the drone as *"a line between your hand and the drone"* as Åsa describes it, you stop analyzing your own or the drone's movements. Instead you enter into the pre-reflective state described above. In Sara's journal, she describes how she occasionally ended up in unexpected, strange positions, without thinking about it, when the relation between herself and the drone was in this pre-reflective state – acting together, in synchrony. For example, in one instance, Sara wanted the drone to come close, and because of the safety distance, she, without reflecting on it, bent her arm into a strange position behind her body. When Åsa saw how close the drone could come to Sara, she became very excited. Sara, on the other hand, reports in her notes that she did not think so much about the orientation of her body parts or muscle tensions, nor did she intend to perform some specific movement. In fact, she was not prepared for how close it would come: *"it felt like it was provoked, came closer, too close to my face. I felt tense, uncomfortable, a little bit scared"*. When this happened, she tensed, contracted her muscles, and began to reflect about the tiniest details of her own bodily behavior, trying to pre-calculate the drones' responses in order to protect herself. To Åsa this offered an opportunity to express a sense of urgency and danger in her choreography.

This sense of dissonance kept happening when the dancer could not synchronize tempo, rhythm and the dynamics of her movements with the drones, oftentimes rendering a feeling of insecurity – the drone's presence would in these circumstances feel unpredictable, unruly and sometimes scary. Åsa says that to her, when the drones do not respond to her movements or move in the direction she is taking them in, she feels the same sort of awkwardness as when a string breaks in the midst of playing an instrument: the feeling of being *inside* the experience is disrupted.

In summary, what is (or rather became) sought here is the space right between when the drones slavishly follow every movement of the dancer versus making them entirely independent, doing their own thing without relating to the performer. When they follow, but with a slight resistance, exhibiting their own 'corporeality', and the dancer is able

to learn how to achieve the connection, changing her movements to fit with their 'otherness', moving together in a pre-reflective manner – that is when the intercorporeality between dancer and drones is achieved and creates for the kind of presence and urgency required for a stage performance.

Scene 2. *The Falling Scene*

In *The Falling Scene*, the drones perform as a Greek choir: their role is to narrate, comment and warn. At the time of this study, the scene did not yet involve human performers on stage. The aim of the scene was to channel the part of the story when Medea decides to kill her children, and came to be characterized by a sense of despair and disaster. It was inspired by the drones 'natural' sound, reminding Åsa and Carl of hovering rescue helicopters entering the scene of an accident. It was also inspired by secondary movements of the drones, such as how they 'wiggle' in the air to balance themselves or move to avoid one-another. In short, while the movement directions of the drones, their goals, are choreographed and pre-programmed, the execution of their movement is not. The drones will try to take the shortest path to reach their position according to the choreography while trying to avoid each other and the boundaries defined by the motion capture system. This creates those secondary, compensatory movements that looks like a 'wiggle'.

Shaping the Drones' Behaviors and Expressivity

In the first part of *The Falling Scene*, the drones rise from the ground one by one to then switch places in an elaborate pattern choreographed by Åsa, one drone at a time. The idea is that each drone takes another drone's place, forcing it to give up its space to the approaching drone. Each drone takes the place of the drone that is the furthest away, making them cover as much space and distance as possible when moving. Åsa's idea was that this would render a bigger impression. After watching the drones perform the sequence according to Åsa's choreography, she tells Vincent that their speed is *"too even"* as they travel across the stage, their movements are not expressive enough. Sara notes: *"I knew exactly what she was talking about. I didn't feel much at all watching them"* Their movement felt boring, monotone, and the drones only felt alive when they appeared to be fighting over each others space as the safety distance made them oscillate a bit before they could carry on.

To Åsa, their behavior became too machine-like: *"If they could be more like a gesture"* she says as she lifts her right arm and swings it in a curving movement from one side to the other. Åsa runs and then comes to a rapid halt: *"like running and then 'whaaaaaa' stopping"*. Instead of moving at an even speed, she is indicating that an expressive gesture needs to first accelerate and then decelerate – otherwise it

Figure 3: Åsa wiggling her torso in a circular motion to feel how the drone picks itself up after falling.

is an unclear gesture [59]. She asks Vincent if he can program the drones' accelerating and decelerating behavior to make their movements more dynamic and intriguing. Vincent explains how the algorithm works, that while it can of course be changed, he cannot see that a change would produce any noticeable difference in the drones' movements. His argument is that because the drones start to decelerate at a certain safety distance to repulsive objects (other drones), their maximum speed is reached too quickly. Therefore, it would not make any difference to the eye if their speed was accelerating and decelerating more or faster. After a long discussion where Åsa and Vincent talked past one another, Åsa attempted to illustrate, using her own body, what she wanted and how the drones' movements should feel: she opened her arms, stretched them backwards, pushed her torso forward, stretching her head and neck upwards, adding a sound: *"shaaaaaaa"*. She said they should be *"more eager to move"*, an expression she connects to a faster acceleration and more dynamic velocity. She explains why she finds the current movement too boring, tilting her head downwards and moving it back and forth, letting her arm make a wavy, slow, repetitive movement, as if she was waddling along like a slow duck. Vincent obeyed her wishes and quickly reprogrammed their behavior by reducing their security distance so that the drones have time to reach a higher velocity before starting to decelerate. When watching the updated sequence, Vincent was still unsure whether the audience (Åsa, Carl and Sara were in the room at the time) would notice any difference – but to his surprise, they all did. To them, this new behavior completely altered the feeling of the scene. The changing dynamic of the drones' movements transformed into something expressive, exciting and engaging, that made the drones come 'alive'.

What we see here is that while Åsa is inspired by the drones' own morphology and behaviors, such as their secondary and unintentional movements like wiggling [60], this does not mean that she simply takes their behavior as given. She needs to control a variety of different aspects of their behavior, much as she would demand from human dancers. To her, as an artist, for the drones to be expressive it is not enough that they move in a certain pre-choreographed

pattern, it is also about *how* they move: *"It is in the way the movement is performed that we can perceive an animate presence"* [59], (p. 14). The drones' secondary movements expresses personality, much like how differences and adjustments in each dancer's individual body make both them and the choreography come alive [60].

Knowing the Drones Through Bodily Experience

As described above, *The Falling Scene* is characterized by feelings of despair. Parts of the choreography is inspired by some of the drones' features that were not intentionally designed, but are simply side-effects of what a drone is. Åsa, Carl and Vincent found that making the drone fly as high as possible (restricted by the roof defined by the motion capture system) 'facing' the audience and then (seemingly) free-fall to the stage floor created a really interesting and expressive scene. It felt as if the drones start by begging the audience for help in desperation to then fall helplessly to the ground as their prayers go unanswered, only to catch themselves right before they crash into the ground.

In the situation at hand, we had only one drone flying. We watched the drone perform a sequence where it rose towards the ceiling on one side of the stage, towards 'the audience', sang an operatic phrase, fell and then rose again to a different side of the stage repeating the movement sequence four times, once to each side of the room.

The fall was a rapid drop as Åsa wanted the fall to be as dramatic as possible. As a consequence of the force of the fall and the oscillation that occurs as the drone tries to avoid getting too close to the floor, it needs to balance itself, creating a wavy, wiggling movement that goes back and forth, around, and up and down for a few moments before it is balanced again. The drone then hovered in the same position for a few seconds before rising again. There was something in this balancing behavior, as a consequence of the fall, that Åsa found to be spectacular. But after the evocative wiggling to stabilize itself, she felt that the drone was hovering in place for too long, breaking the illusion of the fall and recuperation – it became boring to wait for it to act again. Vincent told her that he had programmed it to wait the same amount of time as the length of the singing phrase

the drone performs before falling so that the movement and the singing phrase would synchronize. Åsa, in turn, wanted to express her excitement about the increased drama of the fall when extended with the balancing act (see figure 3): *"I really like when it's falling and "whoo-hooo-wo-wo-wo"*. To emphasize what she had felt, enacting the drone behavior through her own experience, she stretched one arm up and let her body follow, extending upwards, then released her arm and bent her knees, waggling her torso around in a circular, uneven movement, illustrating and feeling 'being out of balance'. She was feeling the wiggling, regaining balance, drone-movement through the movements of her own body, thereby illustrating how it feels to herself, but also to the audience. At the same time, it becomes a way of communicating to Vincent what she finds interesting in their behavior, making sure that he understands what she wants to keep and what she wants to change. She then asks Vincent how long it takes for the drone to stabilize itself. This led to a discussion between her and Vincent on how many seconds he should program them to wait before rising again. Here, Åsa is rapidly moving between feeling and expressing through moving herself, at the same time as she is negotiating and communicating the right timing, translating her experience into technical terms in her dialogue with Vincent.

Imitating the drone regaining balance enables Åsa to get to know the corporeality of the 'other' whose technical body is quite different from hers: *"how would I do it if I was... If that was my body? That's how I always think. [...] it's my way of understanding it [the drone]"*. Sheets-Johnstone [46] saw it as: *"Imitation is not senseless copying but consistently engenders the possibility of deviating from and innovating common practice"*, (p. 358-359). Through observation and imitation, Åsa is developing a sort of kinesthetic understanding of the drones, a process that reveals their expressivity and affordances to her, allowing her to find variations and choreographic opportunities.

Experiencing Audience, Choreographer, Performer

As the creative process progressed, the space defined by the motion capture system felt more and more confining. In *The Conducting Scene*, Åsa had difficulties to get enough space to ever be far from a drone. She felt that she had to stand in one of the corners, moving the drone to the opposite corner of the stage to achieve a sense of distance. When being closer, the drones started to oscillate to avoid her and one-another, a distraction that disturbed her connection with the drones, disrupting the *"line between her hand and the drone"*. When the drones came too close to the invisible walls or roof, there was also a fear that they would continue out of reach of the motion capture system, and crash into the physical wall. When Sara performed with the drones, this fear took over and she usually avoided going too far out on the edge of

the virtual stage and instead kept to the center. The falling movement and expression also changed Åsa's perception of the room. It felt too small for what she wanted the falling to express. In the video, she moved her arms back and forth horizontally, then vertically, as she described how she wanted to expand the space defined by the motion capture system: *"then they can really fall!"*. Åsa illustrated her idea by speaking of how suspension needs to be built up in the scene, how the music and the drones' rising movement needs to build up and up until the first drone falls to create a sense of suspension and relief. She moves her arm up with tension and then suspends it to illustrate how the drones should rise and fall. She tense her shoulders, rising them towards her ears, hunches her back and tense her arms in front of her with palms down, while she sucks in air between her teeth with a hissing sound and then holds her breath. She releases her arms and places her hand on her chest: *"After the first fall they [the audience] should feel like 'woooooaaaah'"*. The fall should create a 'breathtaking-scary-stomach-gut-free-falling' feeling, and the first fall should have the audience think, for a second, that something went wrong with the technology, a malfunction. But as it was now, with this small space, she says, the drones seem *"too nice and cute"*. After expanding the stage, making it taller and wider, the fall became much more expressive. It produced the feeling of a steep slope on a roller coaster ride, an experience of free-falling. Åsa says that we recognize the fall through our own experience, because our bodies respond to gravity in a similar way [59]: *"then you have to get to know this figure's physicality, but my way of getting to know it, is through my own physical body. Not because it is like me, but it is still through that experience, or what I know"*. To Åsa, the way the drone wiggles to stabilize itself after the fall is the way the drone would fall and pick itself up according to its own morphology. The drone *"has to fall like it [the drone] would fall"*, *"they might as well have moved like that or like that... but you don't feel it... you don't feel it physically"*. As Åsa is choreographing this scene, crafting the drone's expressions, she moves between being the choreographer, performer and an audience member herself, a process of transitioning between an outside and inside perspective.

6 DISCUSSION

Let us now return to the questions introduced in the beginning of this paper: *"How can we share design intentions and experiences in a creative process if we employ a first-person perspective? What theories can we use to shed light on and unpack the felt dimension of movement and how novel interactions can be crafted?"*. Our idea was to use concepts from somaesthetics, soma design and postphenomenology to uncover some of the processes Åsa, Vincent, Carl and Sara are engaging in with the drones.

The Mouldable Body – Shaping the Dancer

As Åsa is initiating movement and steers the drones in *The Conducting Scene*, she has to adjust and fine-tune her movements according to the drones' responses, programmed abilities and restrictions. She has to use a language that the drones can understand, thus move her arms and hands in a specific way if she wants the drones to move in a certain way. As described by Birringer [3] and Mullis [37], interaction becomes a dialogue. Through their 'otherness' and differences, the drones come to offer a sort of resistance. Åsa compared her experience to that of playing an instrument, similar to the way Tanaka [52] describes playing an instrument; only when you see the drones moving, or you are moving together with them, you feel what you can do, what the movement is. In other words, Åsa is somaesthetically attending to the drones, to their otherness, changing her movements to fit with them, and at the same time deepening her own aesthetic ability much like the wearers of Karpshevich and colleagues' [21] skirt and Svanæs and Solheim's [50] mechanical tail change their movement patterns, adjusting to a 'new' soma, a socio-technical assemblage.

From Embodiment to Alterity – Shaping the Drones

But it is not only Åsa adjusting. The drones were reprogrammed and rebuilt several times to become more expressive. One such clear shift is redesigning them from mainly acting in an *embodied relationship* to instead offer an *alterity relation*. For example, in *The Conducting Scene*, they initially simply followed her as she moved, and while following is needed to ensure that Åsa feels connected and able to achieve a synchronized rhythm, she also needs to feel that they have their own agency. For example, she wants to be able to get them really close so that she can throw them away or pull them in closer. Sara reports her fear when this happens, and Åsa finds it fascinating. Adding the acceleration-deceleration makes the drones more expressive and their behavior feels more intentional – they become more of the 'other'. Sheets-Johnstone [46] describes this attraction-repelling behavior providing for a sense of agency in animate form elegantly as: "*animate forms that move themselves are drawn toward, and attend to certain individuals, and turn away from or ignore others. In so doing, they testify to a kinetic spontaneity that, in addition to motivation, includes a sense of agency, a species-specific range of movement possibilities, and a repertoire of 'I cans'. [...] Together the dimensions attest to the fundamental power of animate forms to initiate movement, and in initiating movement, to turn toward something.*", (p. 345).

There is an interesting design tension here: Åsa is not looking for an agency that is human-like. She would not want to endow the drones with emotion models or intentionality as if they were human. At the same time, she does not want them to simply follow her in the uttermost machine-like predictable manner. She seeks the drama that arises when they are, on and off, perceived as having autonomy but on their own machine-like terms. To Åsa, when the right balance between machine-like agency and emotionally expressive behaviors was achieved, the drones offered a form of evocative resistance. It is this resistance and otherness that enabled novel artistic emotional expressions. Åsa is an artist, and such she is not aiming to recreate the Medea drama as it has been seen before with human actors on stage. She needs the drones, their lamenting and falling, to induce that visceral "gut"-feeling in the audience that together with the whole horrific event where Medea is killing her children come together into a *novel* experience, a novel artistic expression. The tensions between different emotional expressions, drones crying but still being machines, is not reducible to one emotion. It is an orchestrated whole where the contradictions and tensions are core.

Kinetic Through and Through

Digging a bit deeper into the situations where the creative insights arise, we note how Åsa uses her body-in-motion to both experience and communicate sensations, emotions and expressions. Writing this paper, we were struggling to put words to these experiences: "*breathtaking-scary-stomach-gut-free-falling-feeling*" and "*scary-exciting*". This is not solely a matter of lacking an expressive language. The tacit experiences of our somas are inherently meaningful to us and while language can be used to refer to somatic experiences, it is not until we have had the experience that we fully understand its meaning [15, 48]. As described by Sheets-Johnstone [45]: "*Language is not experiences; it is the means by which we describe experience — or try to describe experience, for the gap between experiential and the language is not easily bridged.*", (p. 148). In the study above, describing the somatic experiences is complicated by the 'otherness' of the drones. It is hard to describe the impact of standing close to the noisy drones as their motors start and they lift, singing their lamentations to express their fear of Medea, to then, just a few seconds later fall down in front of you, nearly crashing onto the floor before regaining their balance.

As we saw in the accounts above, to come to this particular expression – the spectacular falling – Åsa found inspiration in the drones' morphology, how they balance themselves when they encounter other drones or come near the dancer. Åsa imitated the drones' falling and recuperating movements to get a sense of how they can move to evoke emotional responses in the audience, performer and herself. To shape the scenes she moves between an inside and outside perspective, shifting between being the choreographer, performer and imagined audience, between thinking in programming and in movement in order to communicate with Vincent. But her

communication and meaning-making processes are *kinetic through and through.*

Achieving Intercorporeality

Beyond changing herself and the drones, Åsa needs to enact her choreography to achieve an orchestration of the whole experience, portraying a connection between herself and the drones. Kirsh [24] describes how dancers use their body-in-motion to find different ways of performing a choreography. But there is a second reason why Åsa dancing as if she is the drone is important. To achieve a dialogue between bodies, the technological body of the drone and Åsa's human body, an intercorporeality of sorts needs to be *achieved.* The drone's 'otherness' constitutes a challenge to establishing this mutual understanding [35]. Imitation is one of the paths Åsa uses to overcomes this rift. It is important to note that the intercorporeality process is, again, kinetic and perceptual through and through. It is not a process of imitating in order to create mental concepts of what the other (the drone) is doing. Intercorporeality is a process of perceiving in an immediate sense. As Wittgenstein [65] rhetorically asked *"Do you look within yourself in order to recognize the fury in his face?"*, (p. 927). His point was that you do not have to: the fury in the other is apparent to you, as alive as you would feel fury in yourself. We understand in a manner that is *"immediate, automatic, and almost reflex like"* [7]. Höök writes about this mutual understanding with an 'other', in her case a horse: *"You have to recognize the otherness and difference in the horse and create a lived experience together. You have to forget about your own human self and instead turn yourself into a centaur self – consisting of two agents acting together"*, [14], (p. 233). Intercorporeality is, in this sense, achieved, but it is achieved on a perceptual level. As phrased by Game [8]: *"the movement of music, riding, writing, lives in us as we live in it"*, (p. 8). Åsa had to make the choreography *"live in the drones and her own body"* as one.

When Åsa enacts the gesture of acceleration-deceleration or the waggling to recuperate after falling, she is not only communicating with Vincent, she is also dropping into the experience, perceiving it. She is attending to and training her somaesthetic appreciation of the drones. Through imitation and enactment, she finds a path to create kinesthetic meaning-making, whereby some of the drones' expressivity and affordances become revealed to her. As expressed by Hummels and colleagues [13] you need to *"move to be moved"*. These are insights that also align with Gemeinboeck and Saunders [9] work in which they let dancers enter prosthetic costumes of potential robots to explore movement possibilities, where a generative exchange takes place in which the material prosthetic bodies shape the dancer's movements as she shapes theirs. Similarly, Karpashevich and colleagues' [21] interactive costume communicates the character of the

role to the dancer, only revealed when the costume is worn. It is clear that certain creative processes and expressions are only accessible through movement [28, 29, 32].

7 CONCLUSION

We set out to shed some light on and unpack what is meant by a first-person perspective on design, and in particular how these experiences and design intentions are shared in a creative team. To begin to answer these questions, we provided an in-depth account of one such artistic design process — the creation of The Aerial Robotic Choir. Our detailed account of how the choreography and the drones were shaped may provide inspiration to the design and development of novel, creative and affective encounters in human and AI-agent interactions. But more importantly, through the analysis, drawing upon concepts from somaesthetics, postphenomenology and, in particular, intercorporeality, we could shed some light on how movement-based, creative processes unfold. Our account illustrates what happened between Åsa, Vincent, the drones and the choreography, explaining how their creative process became shared between them, overtly accessible to everyone in the room – despite the fact that it concerns inner experiences and meaning-making grounded in movement. These somaesthetic experiences are shared not only through verbal exchanges, but more importantly through movement, gestures, facial and onomatopoetic expressions. Mentis and colleagues [33] share similar insights when it comes to the immediacy of perception in choosing how to move and interact. We show how the choreographer kinesthetically engages with the drones to achieve an immediate connection, an intercorporeality, based on perceiving and acting. It is a process in which she shapes her own soma, not only by dancing with the drones, but also through acting "as if" she was a drone – taking on its body. Instead of speaking of this in terms of embodiment as an effortless experience of being one with the drones, the sought experience is one of resistance, of the 'work' needed to achieve an intercorporeal understanding of the other, and thereby reach richer expressivity. Through our analysis we are able to explain how a shared understanding is achieved when a first-person perspective on what to design is at the core of the design process – thereby demystifying movement-based creative design processes. Meaning-making in movement-based creative processes is kinetic through and through.

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