Vulnerability as an ethical stance in soma design processes

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ABSTRACT

We articulate vulnerability as an ethical stance in soma design processes and discuss the conditions of its emergence. We argue that purposeful vulnerability – an act of taking risk, exposing oneself, and resigning part of one's autonomy – is a necessary although often neglected part of design, and specifically soma design, which builds on felt experience and stimulates designers to engage with the non-habitual by challenging norms, habitual movements, and social interactions. With the help of ethnography, video analysis, and micro-phenomenological interviews, we document an early design exploration around drones, describing how vulnerability is accomplished in collaboration between members of the design team and the design materials. We (1) define vulnerability as an active ethical stance; (2) make vulnerability visible as a necessary but often neglected part of an exploratory design process; and (3) discuss the conditions of its emergence, demonstrating the importance of deliberating ethics within the design process.

CCS CONCEPTS

• **Human-centered computing → Interaction design theory, concepts and paradigms**.

KEYWORDS

vulnerability, soma design, ethics, drones

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1 INTRODUCTION

Physical, emotional, or political vulnerability in engagement with technology is rarely regarded as something positive. Weaknesses in cyber-security, exposing research participants to harm, and the misuse or exploitation of technologies [29, 32] are all examples of vulnerabilities that need to be mitigated, generally through enhanced security measures, ethical research guidelines, or legislation governing the proper use of technology. A similar argument can be made about the design process that leads to novel technologies – whether aimed for 'serious' realms or mainly focused on enjoyment, designers are rarely encouraged to put themselves in a vulnerable position. Yet, recent work by Balaam and colleagues shows how user experience designers in academia are vulnerable and exposed to emotional pressures that often go unmentioned and unmitigated [2]. Balaam and colleagues call for researchers to share the emotional work undertaken during research in formalised discussions – a call we are responding to here. We bring the importance of purposeful vulnerability into the discussion. We argue that vulnerability – understood as an act of taking risk, exposing oneself and resigning part of one's autonomy in a design process – is a necessary condition for interaction design. To build and ground our theoretical argument, we address the role of vulnerability and the conditions of its emergence by analysing and reflecting upon a design process around human-drone interaction.

Our work is situated in soma design [24], an approach to design that builds on a deep, authentic engagement with both ourselves and our technologies. A level of vulnerability is fundamental to soma design's generativity. This is reflected in the use of first-person engagements [25], exposing our inner thoughts and feelings to scrutiny from each other and the academic community; using our bodies to engage with new technologies and design materials [12], thereby opening ourselves up to physical vulnerability; as well as seeking non-habitual experiences [64, 68] by putting ourselves in uncomfortable or unknown contexts. As a methodological requirement, connecting the felt and the reflective, soma design also calls for a systematic and nuanced articulation and documentation of our inner experiences in order to influence our design outcomes [24] and to ensure rigour throughout the process [57]. To undertake a soma design process requires designers to be vulnerable but, in

this context, vulnerability is an active ethical position. We engage in the design process, not as passive human bodies endangered by potentially harmful technologies, but as *"living, sentient, purposive"* [54] subjectivities, actively shaping both vulnerability and risk alongside technology.

The primary contribution of this paper is theoretical, but we illustrate our points by presenting an empirical analysis of a soma design process aiming to create novel interaction possibilities between drones and their pilots. (We do not go into the details of human-drone interaction research, such as [36, 71], or the problematic history of drone technology [6, 59], as our primary goal here is to concentrate on the details of the design process and its relation to purposeful vulnerability). Using a combination of ethnography, video analysis and micro-phenomenological interviews [4], we trace the development of our design explorations and discuss the fundamental role vulnerability plays at different stages of the process; from early playful design explorations; to an accidental, but fruitful, breakdown involving a collision with a drone; to focused collaborations seeking novel experiences and devising novel interaction possibilities, such as controlling a drone through singing together. The analytical section of the paper presents the course of the design process through three ethnographic vignettes, illustrating significant moments of our explorations. Each of the three fragments adds to framing how vulnerability is enacted. The first clarifies our understanding of purposeful vulnerability and demonstrates how it is accomplished in the interaction with technology. The second shows how breakdowns can be fruitful for design and exploration of what we will frame as *felt ethics*. The third focuses on interactional work[1] we perform to cultivate vulnerability during our design sessions.

With our analysis, we advocate to expand the discussion of vulnerability in interaction design and, more broadly, in our relationships with technology. Rather than discussing vulnerability from the perspective of exposing others to harm, we address how one's own vulnerability can be cultivated in the design process. First, we show that purposeful vulnerability, addressing our physical, emotional, reflective, social selves as a whole is a necessary pre-condition for design work aimed at exploring non-habitual behaviours and experiences. Even though the state of vulnerability is not specific to soma design, the non-habitual and body-centered process of soma design foregrounds vulnerability as an active ethical stance, and as the outcome of interactional work that designers purposefully engage in. Second, we demonstrate the quite tangible risks involved in using our bodies to engage with new technologies – our sociodigital materials [24] – as well as the work and care that are required in a design team after a breakdown or failure takes place. Breakdowns, however, can open up a space for negotiating ethics and create a possibility to alternate our habitual ethical responses. Thus, they should not necessarily always be avoided. Third, we illustrate how to cultivate the vulnerability inherent in design methods that purposely seek non-habitual action or novel experiences as resources for design work by staging conditions that are favorable for its emergence. As we will argue, it is not until we break with the habitual and normative using our whole *somas*, that ethical choices deeply ingrained within us reveal themselves – they become *felt* experiences, as a crucial complement to intellectual discussion of risks.

[1]Interactional work here refers to the work we perform to coordinate even simplest collaborative activities, such as walking together or taking turns while talking.

2 RELATED WORK

Let us start by introducing soma design. We will then move on to describe how vulnerability has been discussed in the literature and how it concerns not only our bodily integrity, but how it is also enacted between us – intercorporeally – and between us and the environment. After that, we provide a brief account of the ethical foundations of soma design to highlight the often-neglected role of vulnerability in developing ethical sensibilities.

2.1 Soma design

Our work is situated within soma design [24], rooted in theories of human morphology and movement [51, 52] and the philosophy of somaesthetics [53, 54]. The term 'soma' encompasses our non-dualistic self – subjectivity, body, emotion – as one whole. 'Aesthetics' refers to how we experience and engage with the world around us. As a pragmatist philosophy, somaesthetics advocates for a practical, analytical, and pragmatic approach toward bodily cultivation to improve our 'tool of tools', as Shusterman frames our bodies, for acting in and experiencing the world [54]. These concepts have deeply informed soma design as a practice. Starting with movement as the foundation of experience [52], soma design encourages designers to pursue a bodily, felt engagement with their design process and materials, to better understand values, ethics, meaning-making processes, and ways of engaging with the world [24]. It answers to the evolving landscape of ubiquitous and wearable technologies, biosensors and actuators, and other technologies that increasingly engage our whole bodies in interaction.

As such, soma design methods are generally centered around first-person perspectives [25] or autobiographical design processes [42], involving the training of designers' aesthetic sensibilities by engaging in bodily practices (sometimes led by somatic connoisseurs [49]), material and technological explorations of their design materials [55, 69], and their experiences of the artefacts being designed [62, 64]. Soma design uses the designer's own lived body [38] as a resource for design, with the aim of better understanding the technologies that others will ultimately experience.

Soma design could also be regarded as advocating for not just aesthetic ideals, but also ethical ones. The somaesthetic project positions the body as the *'somatic template'* that guides our empathy and understanding with others [54]. Thus, through reflective engagement with design materials [50], designers can better understand the implications of design decisions, the *'sedimented movements'* [12] embedded in technologies that others will experience, and how these movements will shape others who use such technologies. This has also been termed an *'ethics of self-use'*[42].

Soma design does not completely adhere to the idea of 'flat ontology' [8], which removes any distinction between human and non-human entities. Rather, it prioritises individual experience as a starting point of design exploration. However, similar to 'more than human design' [21], soma design challenges the user-centered framework and goes beyond a functional view on human-technology relations, accepting multiplicity of agency and complex relations

between human and non-human actors [35]. Soma design explores other forms of connection between humans and non-humans, such as the relations of correspondence [28] or connecting with the alterity of the non-human [31].

2.2 Vulnerability and intercorporeality

Vulnerability is a complex concept that takes different meanings in different contexts. For instance, in interaction design, vulnerability is often seen as a quality associated with sensitive topics [67] or particular groups, such as children [48], elderly [58], people who identify as LGBTQ [18], or people with disabilities [3]. In cyber-security, vulnerability is seen as a weakness that exposes a person or organisation to intrusion, theft or fraud [20]. Connecting to the purposes of this paper, vulnerability can also be regarded as a foundation for our intercorporeal relations, both with others and in our relationship with technologies [22]. As highlighted by Grosz, the essential vulnerability of the human body is a condition for intercorporeal relations as *"the body provides a point of mediation between what is perceived as purely internal and accessible only to the subject and what is external and publicly observable"* [22]. Further, the vulnerability of bodies exposed to technology has a potential to create connection and social cohesion by creating shared experience and bridging together internal experience and that which is publicly observable [22]. As such, Meyer et al. argue that our mediated relationships with and through technologies can also be described in terms of intercorporeality [39, p. xxix]: technology offers the possibility to mediate relationships and create a space of intercorporeality through articulating this essential vulnerability of human bodies.

Intercorporeality, in its essence, refers to the idea that communication, coordination and meaning-making are situated in the shared pre-reflexive and pre-conditional space of our lived corporeal human bodies. Fundamentally, it is based on the idea that we are inherently social beings and our sociality resides on the corporeal level rather than on the level of symbolic interaction. Sociality, as an ability to share meaning and coordinate activities with other human beings, exists before we are able to articulate it in the form of rules or guidelines. Meyer et al. draw on Merleau-Ponty's definition of intercorporeality to refer to all of our interpersonal abilities, or more specifically *"a radical and coherent conception of the human body as being constituted by its corporeal relations and interactions with other human or animate bodies — a conception, that is, in which the body is never alone in the first place, or only in conditions of deprivation that we recognize as inhumane"* [39, p. xviii].

Similarly, soma design adheres to the idea of human cognition as corporeal [24], which presumes that knowledge, perception and cognition are not individual mental states, but intersubjective phenomena residing in the pre-reflexive interaction between lived human bodies [16, 38]. Rather than assuming that we first develop inner mental models of the world, which are then shared with others through symbolic language, phenomenology – and more recently soma design – consider intercorporeality as a space where knowledge, creativity and ethics are first created and experienced through pre-reflexive bodily sensations, which can then be translated into a symbolic form or an artefact. In another scholarly tradition, ethnomethodology and conversation analysis develop the meaning of intercorporeality further by demonstrating that not only symbolic knowledge but physical sensations, such as taste or smell, are co-created in multimodal human interaction, which goes beyond lexical sounds and includes gestures, gaze, and coordinated movements [40, 41].

In the same way as phenomenology considers perception and knowledge as located in the space of interporeality, ethics can be considered as situated in pre-reflexive corporeal experiences rather than solely formalised lexical rules. Ethics-in-action, then, can be primarily felt and observed in the space of intercorporeality – in the interaction between human and technology where both engage in habitual ethical behaviour, which can later be translated to the symbolic level and/or changed. In HCI, Eriksson et al. [13] have explored the relationship between ethics and intercorporeality by designing movement-controlled drones to be used on the opera stage as part of an artistic performance. Their study showed that the choreographer, Åsa, by first learning to shape her movements to best control the drones, thereby also learnt how to recognize when others were afraid of the drones. By drawing on her skills as a choreographer, Åsa could then work with the dancers to help them overcome those fears. In this way, Eriksson et al. [12] expand the conversation on ethics as dynamically unfolding in relationships between humans and drones and also include to it aspects, such as movement, empathy, and artistic expression. The work of Eriksson et al.[12, 13] indicates that a creative and generative design process requires taking risks and being exposed in various ways to others, but also learning to do so with care and empathy.

2.3 Processual ethics in interaction design

There have been calls to examine ethics as situated in the interaction between design practitioners, participants, and technology, including the concepts of in-action ethics [15] and micro-ethics [33, 56]. These draw attention to how ethical decision-making is *enacted* within the research process, sometimes outside the scope of what is prescribed to be ethical or moral action by overarching ethical approval processes and 'check-list' approaches to ethical conduct. These studies view ethical decision-making as located in everyday practices and micro-decisions, which are often not explicitly negotiated. Rather, this negotiation goes unnoticed as it is embedded in the unfolding of the event at hand. It therefore becomes important to make the conditions necessary for micro-ethics visible for explication and reflection. The ultimate goal here is to develop ethical sensibilities and, when needed, change our habitual behaviours that are deeply ingrained and often taken for granted.

From the perspective of enaction, Varela [65] points out that ethics is an affair closer to corporeal wisdom rather than reason. He criticised how Western thought emphasises ethics as a synonym of moral behaviour or what is right, in contrast with what is good. This argument resonates with Shusterman's project of ethics, understood as grounded in the body towards living a better, more virtuous life [54]. Under this perspective, a virtuous person – one who has acquired good habits throughout their life – somatically *knows* what is ethical and engages in such actions. This perceptual sensibility places ethics as part of our everyday processing of the world rather than a predefined set of rules that are external to our subjectivity. For instance, if we have a lively conversation with someone and

start *noticing* that the topic makes that person uncomfortable, an ethical impulse would be to change the subject to make the person feel safe again. In that sense, ethics is something we perform and experience somatically and generatively [12]. Although most of these micro-ethical decisions are made without much reflection, our ethical stance can be trained and refined by accessing the non-habitual as a way to bring to the fore the implications of our actions. As exemplified by Shusterman, if a woman starts experimenting with sitting like a man, it is quite likely she will start noticing how social norms associated with gendered behaviour are ingrained in her habitual ways of being [54].

This is why soma design emphasises defamiliarisation techniques to help purposefully examine our somatic experience and ethics [24]. Through doing the habitual in a non-habitual manner, we may uncover deeply ingrained habits and feelings, making them attainable for change and improvement. Those changes may very well be slow and difficult to make. For example, it may be difficult for a woman to learn being assertive in a way that is not socially considered to be appropriately 'female'.

Processual approaches view ethics as a part of everyday performance, shaped both by individual, subjective and felt senses and social rules [19]. In HCI, the subjective nature of ethics is acknowledged by Loke and Schiphorst [37], who stress that connecting with designers' somatic sensibilities constitutes the first step towards empathizing with others. As a potential method to engage with this approach to ethics, they suggest training designers in somatic connoisseurship [37]. Becoming a connoisseur involves training oneself to guide others into unfolding their somatic sensibilities and helping them bring out qualities to inform the design process [49]. It also allows designers to actively discern between different somatic markers for design and actively connect with the subjective experiencing of those involved in the process [24]. This can be done, for instance, by adjusting part of the somatic guidance, such as slowing down some bodily movements, or by modifying the wording of a guided body scanning. This process of somatic discernment involves a generative pondering of ethical micro-decisions along the way. This is particularly evident in the work of Spiel et al. [56], who build on the concept of micro-ethics from the medical professions; the ethics of *"what happens in every interaction"* between individuals [33], to show how small ethical decisions were constantly enacted and reflected upon in the context of participatory design with children with autism.

Ethical decision-making can similarly be considered as enacted within our interactions with technology [12, 13]. Using a postphenomenological lens, people and technology are mutually constituting one another – each evolving and shaping the other[27, 47, 66]. Taking this mutuality into account, *in-action* ethics foregrounds the importance of ethical reflexivity through participation, drawing connections with the way design is fostered through reflection-in-action [15, 50]. Similar to micro-ethics, this encourages a different approach to considering how ethical decision-making unfolds in human-technology interactions. Those changes can be uncovered through attending to bodily sensations and experiences altered in the interaction with technology. Our work on vulnerability thereby follows and extends prior studies of processual ethics in HCI. We bring attention to an important yet often neglected aspect of developing ethical sensibilities: purposefully engaging with vulnerability in the interaction both with technology and with other members of a design team.

3 DESIGN PROCESS AND METHODS

Let us now turn to our soma design process. Our initial aim was to explore and design relationships with drones as *'the other'* – a distinctive and separate entity, which is neither completely controlled, nor fully autonomous. We were curious to see if movement, dance, or singing could allow us to direct, influence or *correspond* with drones as if they have some form of autonomy or intentionality. The work built on earlier projects by La Delfa and colleagues [34, 35] and Eriksson and colleagues [12, 13]. More importantly in this context, we aimed to explore where and how the felt dimension of ethics arises – if at all. We wanted to document and understand *the felt experience of ethics* in relation to interaction between humans and technology as well as to explicate where ethics is situated in the bodies of those engaged in the interaction.

We did not initially plan to explore group relationships or vulnerability, but both became central as the design process required us to explicate our feelings and expose ourselves to discomfort, without having any previous experience of working together. The design process was an exercise in collaborating together as a group, getting to know each other, as well as developing trust in both the research group and the process itself.

We started our exploration as a group of five women, although later it was mostly four of us who attended the design sessions. (One of the authors joined us at the analysis and writing stage; additionally, other members of the extended design team occasionally joined us in the design exploration.) The core design team consists of four members. One of us is a professor already established at the institution, one is a postdoctoral researcher newly arrived at the university, and the remaining two are PhD students in the early stages of their research. The design process was the first time, when we were actually working together. Previous interaction had been limited to at-distance meetings where we discussed theoretical aspects of our research. Three of us were relatively experienced in soma design, while one did not have any previous design background. Each was coming from a different country; we collaborated in English, but only one of us has English as her first language. We differed in age, class (although the definition of class becomes problematic when one moves abroad), country of origin and social background, even though each had at least a Master's level degree. We were situated in a research institution in the Global North, which presumes a significant degree of privilege.

3.1 Design process and vulnerability

To provide some context to the situations under analysis, we first outline our broader design process. Each situation occurred during the first year of an ongoing soma design process exploring novel interactions between humans and drones, aimed to go beyond the forms of subordination and control. Our design process aimed to explore ways of interacting with drones beyond a simple flight controller. This included augmenting the flight experience with different modalities of feedback such as heat, air, and vibrations as well as investigating ways to engage the whole body in interaction with the drone. During the first year, we had 15 design sessions,

starting from a week of intensive bodily work and followed by regular design explorations which took place once or twice a month. During these sessions, we engaged in material explorations supported by artefacts created as part of the soma design methodology, such as Soma Bits [69] and inflatable pillows [31]. We followed soma design methods, first sensitising our bodies and aesthetic sensibilities [24] by working closely with somatic connoisseurs [49]. We then moved onto technological explorations involving small TELLO drones[2] to familiarise ourselves with the felt experience and material qualities of our design material. We started by introducing the drone into the design process to explore its material qualities, as well as our sensations and feelings of the drone. Following this, we moved onto more in-depth ideation by combining the drone with other technological artefacts. Currently, we are engaged in more structured collaborative workshops with a series of somatic connoisseurs to explore specific interactional qualities, such as sound and coordinated movement, in greater depth.

3.2 Documentation

To document our design process, we used an ethnographic approach supported by several methods. After mutual consent, we video recorded our design sessions, including physical exercises, experiments with drones, props and materials, as well as our reflections after each session. We also kept a collaborative diary with field notes, which included our reflections, sketches and body maps [26], articulating what was meaningful to each one of us. In some cases, we used soma trajectories [60] as a method to illustrate and describe the temporal aspects of our experiences unfolding along the dimensions of specific somatic qualities. After an accidental drone collision, we conducted two micro-phenomenological interviews [4]. This interview method elicits detailed descriptions of an evoked experience, including both synchronic (the cognitive, sensory, and emotional) and diachronic aspects (referring to the unfolding of experience over time) [45]. This method focuses on the how instead of the what of the experience, assisting the participant in eliciting sensations, feelings and fine-grained descriptions of the given phenomenon [44]. One particular aspect of micro-phenomenology is that all the questions are content-empty, deriving exclusively from what the participants decide to share. A micro phenomenological session starts, when the participant is asked to focus on a specific moment of the experience. This moment is generatively examined with the help of the interviewer, who asks questions to zoom in on the how of the experience. Once the interview finishes, the interviewer recapitulates the content of the dialogue. Revisiting the content has two functions: (1) to ensure the experience was captured with precision, and (2) to confirm the participant's consent. Here, we used video recordings of the drone crash as a prompt to evoke fine-grained descriptions of the procedural aspects of the experience from the standpoint of both the *'collisioner'* and the *'collisionee'*.

3.3 Analysis

The three vignettes presented here are outcomes of slightly different analyses. For the first and third examples, we used video recordings of the sessions to create detailed descriptions of our design activities, and then selected the excerpts that best illustrate the role of vulnerability in our work. The second example presents findings obtained through a combination of ethnomethodological video-analysis [23] and micro-phenomenological interviews [45]. Within two weeks after the crash, we conducted and video recorded micro-phenomenological interviews with the two main participants in the crash. Each interview took approximately 90 minutes and was conducted by a practitioner, who had received a week of training in micro-phenomenology, and was supervised by a certified practitioner of micro-phenomenology. We also prepared a detailed transcription of the drone crash video excerpt using ELAN software[3] to analyse the circumstances of the crash and the subsequent repair work done by the design team. We transcribed and analysed the micro-phenomenological interviews with a thematic analysis approach [7] to generate relevant themes: the alternated experience of time during the crash; the feelings evoked by the crash; and the material qualities of the drone revealed by the crash. The interviews were first coded by one of the authors and the initial set of themes was then presented to the group together with findings from ethnomethodological video-analysis. After discussion, the first analyst continued the analysis of the interviews iteratively, together with the other authors. The results presented in this paper combine the findings from video analysis and the interviews. The final selection of themes presented in this paper was guided by our intention to use the empirical analysis to highlight our theoretical argument. Our theoretical focus was also a key reason for why we approached micro-phenomenological interviews with thematic analysis and substituted a detailed transcript of the video with ethnographic descriptions. While our data contain more possible themes, we purposefully selected our empirical examples to highlight the aspects relevant to our discussion of vulnerability. The selection work was done collaboratively by all the authors during three meetings that were specifically devoted to data analysis and coordinating the writing process.

While we consider it necessary to expose our inner thoughts and experiences to scrutiny within the design team and in the context of the design process – allowing ourselves to do our best work through being vulnerable, candid, honest, and awkward in ways we might avoid in other professional settings – in what follows, we use pseudonyms to reference the team members. We have made the choice of using pseudonyms as an act of care, to avoid unnecessary discomfort, and to make it possible to open up our design process without limiting our capacity to express the issues at stake.

4 VULNERABILITY IN A DRONE DESIGN PROCESS

We now turn to our analyses of the three examples chosen to represent different stages of our design process. Though not indicative of a final design outcome, these examples trace the development of our design process during a year of explorations and depict vulnerability in different stages of the design process. The first example from an early exploration aims to demonstrate that being vulnerable, i.e. engaging oneself with the non-habitual ways of moving

[2]These are small, lightweight quadcopters often used in educational contexts. https://m.dji.com/se/product/tello-edu

[3]https://archive.mpi.nl/tla/elan

Figure 1: Olivia sits in a beanbag while Maria and Maxine control actuators

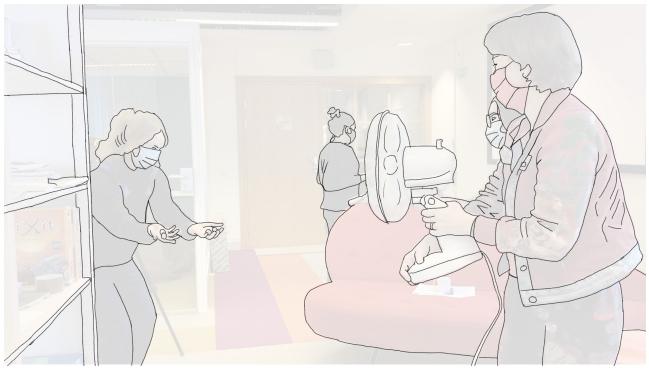

Figure 2: Lena and Maxine explore airflow using a fan with Anna and Maria in the background

or interacting, requires effort and that technology can prompt vulnerability. The second example is taken from a later stage of the process when an accidental, but ultimately fruitful, collision occurred when imagining novel ways of controlling the drone. The example represents a break of normality, which generates insights about the drone's materiality and opens up a space to deliberate ethics in the group while mitigating the aftermaths of the drone crash. The third example reports on our exploration of controlling the drone through singing with it. Using examples from earlier and later stages of our work, we discuss the different shapes that engaging with the non-habitual takes as trust within the design team develops over time.

4.1 Early engagements with the drone

The example analysed in this part is taken from our first session devoted to exploring the drone as a design material, its interactional qualities, as well as the sensations and feelings associated with controlling and being around the drone. This exploration took the form of a workshop where five members of our design team gathered together, planning to take turns in flying the drone, to ideate, and to experiment with other artefacts in the room. It was the first time when we went from talking about drones to actually experiencing them together. The session was devoted to inventing novel ways of engaging with the drone.

To stimulate our exploration, we were using a TELLO drone, but we tried to go beyond its embedded functions and ways of being controlled. Through Wizard of Oz-inspired interactions [10], we explored novel ways of engagement with the drone, for example: using vibrations as a way to 'feel' the drone (See Figure 1); gesturing at the drone to make it move (See Figure 3); imitating its sounds; or experimenting with the weight of the drone. Both the use of the drone and other artefacts – such as vibrating actuators, strings and a fan (See Figure 2) used to imitate or influence the drone's airflow – were aimed to stimulate non-habitual engagement in order to counteract the obvious, thereby exploring what *could be*. This process often left us feeling awkward and embarrassed – not only because of the activities themselves but because of the uncertain outcomes.

As we will demonstrate in the following ethnographic account, vulnerability here related to experimenting with the unknown and defining the borders of what is possible. We prepared the engagement to a certain extent by establishing its structure: our sessions had specifically assigned hours, a warm-up activity where we started from sharing our body maps[4] and openly discussing how each of us was feeling that day [26], and a concluding discussion where we tried to make sense of our daily explorations. Despite the presence of structure and artefacts stimulating exploration, as well as an overarching commitment by all participants to engage in soma design explorations, a lot of emotional work (as discussed by Balaam and colleagues [2]) was needed to ensure that we would dare to be vulnerable in a social group where we had not yet built sufficient interpersonal trust. Vulnerability at this stage was required to engage in the exploration despite the risk of looking silly, suggest new ideas that could be abandoned, and engage in activities that might not be supported by others.

However demanding for the team members from a psychological perspective, the exploration was also both supported and challenged by the fragility of the drone itself, as the following ethnographic description illustrates: *We started by engaging with a TELLO drone, a small toy-drone, using it as a first model for our future customized drones. Getting it up into the air took some time as the drone's software needed to be updated. When the drone finally took off, it created an unexpectedly loud sound and simultaneously generated a fairly strong airflow – despite its smallness. This immediately attracted everyone's startled attention. Olivia, who was driving the drone, made it make a few flips. The group responds strongly – imitating fearful screaming, laughing, and mocking panic. The drone immediately changed the atmosphere in the room. The laughter and screaming were liberating – they broadened the borders of what would be allowed and turned the design exploration into a playful activity – not an intellectual exercise. Our emotions grew stronger when we tried teaching one another to fly the drone: there was an over-demonstration of fear and fake screaming, creating an atmosphere of a children play. We drove the drone for a short while until it crashed into a bookshelf and one of the propellers broke, after which the drone was unable to fly. This failure called for a break in our joint activities and evoked a discussion on the fragility of the drone and the difficulties in controlling it.*

[4]Body maps are the instruments to visualise participants' bodily sensations. For more details see[9]

Figure 3: Lena and Anna simulate controlling the drone using gesture while Maxine watches

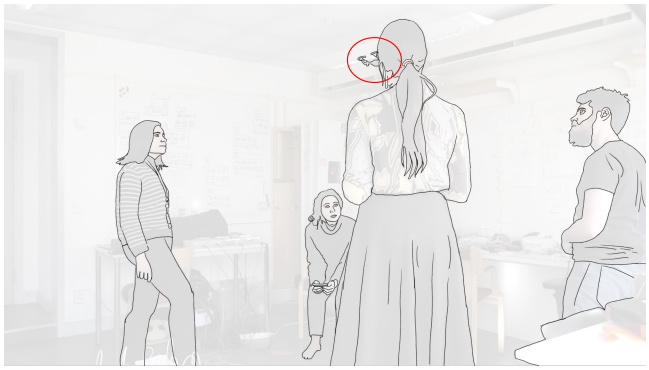

Figure 4: Maria, Lena, and Patrick watch as Olivia flies the drone

While the drone here indeed became *the other*, a potentially dangerous and fear-evoking technology, one of the first things we learned during this design exploration was how the drone itself was more fragile than expected. These small TELLO-drones can be seriously damaged by the tiniest crash; they have extremely short-lived batteries, requiring constant monitoring and recharging; and they depend on external software. Vulnerability here does not exclusively belong either to people or to technology – it is a state created in the situated interaction between humans and fragile drones. The presence of the drone, provoking laughter, mock screaming, and – later – care, acted as a catalyst for creating a space for playful – and vulnerable – exploration. In these design explorations, we also ascribed intentionality and agency to the drone, interpreting its flashing LED "eye" and jerky movements as purposive or communicative. We reconstituted the drone from being something simply fragile into something 'vulnerable'. Here, vulnerability and risk are actively co-produced in the interaction between us as a group of designers, with our designerly aims and fleshy bodies, and the drone technology with its technological affordances and fragile plastic body. The space to be vulnerable, to engage with an unfamiliar technology, in non-habitual design activities, and risky exploratory ideas, is a product of interactional work within the assemblage of humans and drones.

4.2 Drone crash

This session analyses how the risks associated with being vulnerable while engaging in design explorations at times become, not only a felt problem, but a physical, emotional or social risk of harm. While we would not advise designers to deliberately put themselves at risk, we show how such unexpected and potentially harmful breakdowns may be generative to design. We do it by analysing an incident where the drone accidentally collided with a member of our design team. The crash became a break-down of normality, which, instead of violating our mutual trust and derailing the design process, was successfully resolved, leading to an active engagement to build trust, practice care while mitigating the crash consequences, and articulate ethical stances important for our team. Beyond this, the breakdown became a focal point of both our analysis and designerly explorations, leading – as failure often does [14, 43] – to new insights into the drone as a design material, and the role of the drone in our ethical action.

The crash occurred during a session where we were exploring inflatable materials (shape-changing inflatable cushions powered by pneumatic actuators and controlled by a mobile application [30, 64]) as a novel way of controlling the drone. The shape-changing feedback from the inflatables also interested us as a way of conveying the feeling of 'being' the drone – by imitating the pressure 'felt' by the drone moving through the air. Midway through this session, we decided to incorporate the drone into our exploration. We began to fly the drone around the room and ideating possible responses to the manipulation of the cushions. At several points during this process, it was noted that the blinking LED on the front of the drone was reminiscent of an 'eye'. Controlling the drone whilst it 'looked' at us gave the interaction a particular dynamic. Interested in exploring this further, Olivia brought the drone to eye-level with Maria, who placed her foot on an inflatable pillow and acted as if she was controlling the drone (see Figure 4). What follows is a short description of the incident based on the video recorded that day.

Olivia starts flying the drone in the room, while Maria is dealing with an inflatable pillow attached to the floor, pretending to operate the drone with a foot. Lena and Patrick are in the corners of the room, observing the scene. After about 30 seconds of flying the drone, Olivia by mistake drives the drone into Maria. The drone crashes into Maria's face, creating panic in the room – but as it turns out, luckily not causing any serious physical damage to her. After the crash, Maria freezes for a few seconds and the other group members are scared. Their bodies manifest fear: shrugging, jumping back and protecting their heads with their arms, or shouting in fear. After this very brief moment of panic, the group starts repairing the damage. Olivia rushes to Maria and helps to untangle the drone from her hair, checking if there is any physical damage. Olivia explains her mistake and repeatedly apologizes. Maria ensures she is okay, not seriously damaged, and does not think the accident is serious. The first round of apologies makes the group more relaxed and alleviates the tension. Once this is established, Maria and Lena are attempting to make jokes about the crash, but the laughter of relief does not happen until Maria repeatedly confirms that she is alright both physically and psychologically and Olivia gets the space to explain herself and receive the confirmation that there are no hard feelings in the group.

4.2.1 Breakdown. The crash momentarily pulls us away from playful, lighthearted exploration. As Maria described in the microphenomenological interview[5]: *"it was suddenly serious. So the weather changed. And with that, my engagement with the drone. So from playful and fun and 'oh, look at these wzhoo, wzhoo, wzhoo sound and the correspondence between two things and the mapping between my right foot and the movement of the sound suddenly became this staring contest. This moment of…* ***this challenging moment between 'the woman' and 'the machine'.***"

Several factors led to this crash. In part, the collision occurred due to the different orientations between the pilot, Olivia, and the drone. Olivia believed that she was going to reverse the drone away from Maria, but accidentally moved it forwards causing it to collide. Maria also made a deliberate decision to not move away from the drone in the moment when it approached her, choosing instead to explore a 'staring contest' with the drone. When the drone approached Maria, she remained still, almost in a frozen posture, and watched it approaching her without turning away. She describes the eye contact with the drone as a competition between her – "*a living, fleshy human*" – and the drone machine staring back at her with its led-light 'eye'. She explained her decision to remain static as a deliberate choice making sense in the staring contest between her and the machine. Though the drone's control system and pilot error played a role in causing the crash, the collision ultimately arose due to our decision to accept the risks involved in bringing the drone into a shared space. The crash also occurred due to the determination to treat the 'staring contest' between Maria and the drone as a part of the ongoing exploration and make the active decision to engage in the situation rather than retreat.

"At some point it [the drone] went out of control and I saw it approaching and it was a moment of stillness. ***I was resistant to move deliberately****". […] There was a sense of anticipation that the drone was coming and this stillness. I think I was looking. I was looking to the drone and there was this moment. I wouldn't say like a staring contest *laughter* but this strange encounter between a woman and a machine face to face. […] I had this sort of a staring contest with the drone because* ***I was a body, an organic biological woman in front of this inert cold artificial thing****, and I became a body during that second, and my mind was empty. [...] And that stillness was physical and perhaps spiritual in a way. It's like who is gonna win this staring contest is it drone or is it me."*

The collision created a moment of intimate connection between the two people actively participating in the event and the drone, when human-machine interaction becomes distinctly felt, immersive, and non-reflective. Maria describes it as a moment of a sudden presence one-on-one with the drone, when she immerses in her body to realize herself not as a participant of the social interaction but as an organic human being, a woman, being caught up in a contest with a **'cold artificial thing'**. In contrast to the previous moments of sociality with its playfulness and awkwardness, this breakdown constitutes a moment where Maria becomes hyperaware of herself in relation to the drone. However, instead of isolation, her account indicates an experience more akin to solitude, as she describes in the interview: *"this stillness was perhaps a brief moment of contact with my body, where I could feel myself breathing and I could feel my heart beating."*

The moment of the crash, the breakdown between ourselves and between us and the drone, became a focal point of our design exploration. The crash added new dimensions to the materiality of the drone. At the beginning of our design process, we sought to understand the materiality of the drone as a design material and its interactional qualities – both fundamental to future design work. Intermittently throughout the process, we treated the drone as 'the other'; a robotic alien-like body moving and behaving in ways unavailable to us; a potentially dangerous and somewhat unpredictable yet fascinating device that drew our collective attention like a new toy; a vulnerable design partner in need of repair; an inscrutable assemblage of inert parts which, for reasons unclear to us, refused to operate during our design sessions. We variously discussed the drone's presence in terms of noise, airflow, and danger, but the drone's 'presence' in the room was seemingly distinct and separate from its easily broken plastic parts.

The crash synthesised our corporeal understanding of the drone. In the moment of the crash, our encounter with the drone became *felt* through the artificial lightness of its plastic, its small sharp propellers, the contradictory orientation in the air, its high susceptibility to the air flow direction, and our lack of control over it, in sharp contrast to our soft, fleshy bodies. This crash represented a breakdown in the assemblage of humans and drones, and it is through experiencing the visceral, bodily roots of our vulnerabilities, that we came to a greater understanding of our design materials and our relationships to one another. This opened up the space for ethical action.

4.2.2 Felt dimension: vulnerability of human bodies creates empathy, repair produces social cohesion. During the crash, the drone hit Maria on the chin and the drone's propellers continued spinning for a short moment after the crash, threatening to cause even more damage. Even through only Maria is at physical risk, all group members displayed shared feelings of fear and panic: Lena cringed in her chair, Olivia flinched and recoiled slightly. The breakdown made our vulnerabilities available for others. Rather than disrupting the connections between the group, it generated empathy and provided space for concrete ethical action.

First and foremost, it opened a space of care. Immediately after the crash Olivia crossed the distance between her and Maria to untangle Maria's hair from the drone. Maria, in turn, froze for another few seconds as if the collision temporarily deprived her of agency and placed the responsibility to care on Olivia. The breakdown altered the conventions of normality: despite COVID restrictions and norms of individual privacy, care and close physical contact became needed.

The rest of the group also got involved in mitigating the consequences of the crash. This repair work included establishing that Maria was not physically harmed, providing space for explanation, and ensuring that all remaining tension was discharged through a joke about "*the new functionality of a drone-hairdresser*". The laughter at the end of the incident was quite different from the laughter at the beginning of our design exploration. Now we were laughing *together* indicating that the situation was not dangerous for the

[5]the fragments marked in bold are our interpretation of what is most relevant in the excerpts

group and that we were able to collectively recover from a potentially problematic breakdown. Overall, the crash opened up the space for deliberating ethics. Even though we did not explicitly discuss how we as a group should mitigate the breakdown, we made ethical choices – habitually – engaging in care work, making collective efforts to save the group's integrity, and saving our social faces. Following the crash, we engaged in discussions and conducted micro-phenomenological interviews on our experience of the crash. This allowed us to reflect in depth on the ethical actions and micro-decisions we took in the challenging situation and, eventually, make sense of the crash.

One of the important outcomes of the crash was discovering our group dynamics as a resource for design, prompting us to explore collective ways to interact with the drone. Since we successfully repaired the situation and were willing to take responsibility for the collision, the breakdown enhanced trust within the group. An event that could have led to resentment and distrust, fear of experimenting, or negative conclusions about our practice, instead became a fruitful field of exploration. Not only did we 'survive' the event, but the repair and sense-making after the crash brought to the fore values shared by the group: physical integrity and safety matter, but risk is accepted; mistakes are forgiven; carelessness is problematic; the dignity of all group members is important – in the aftermath of the crash, all of these became topics for discussion and material for building stronger agreement. The breakdown also highlighted that the interactional work needed to create a safe space for vulnerability is pervasive in our design sessions – even in everyday situations where breakdowns do not occur, as the final example will demonstrate.

4.3 Singing with the drone

Engaging with the non-habitual requires continuous work, the shape of which changes when we grow to trust one another as a team. The following section analyses two excerpts where we explored a non-habitual action – singing with the drone – to highlight the interactional work performed to achieve the state of vulnerability we deem necessary for soma design. The first excerpt is taken from our early design explorations and the second from a more structured workshop that was led by a professional singer. In both, we examine the ordinary ethical work that takes place to enable non-habitual engagement.

The first ethnographic description depicts the early stage of our process, during which we struggled with embarrassment and often created an emotional distance between ourselves and our exploration, for example, by using laughter as a way of resisting engagement. However, the moments of overcoming this resistance often led to powerful discoveries which furthered our design work. One example of this was singing with the drone – an ideation activity during one of our first sessions where we explored controlling a drone with sound. Here, the singer Natalie, made the decision to engage seriously and authentically in the activity despite the embarrassment involved. Her decision to be vulnerable and actively engage in the process later helped us to recognize a potentially interesting design space.

Next iteration continues the sound exploration with the help of Natalie – a professional singer working on her projects in the extended group. Natalie starts from producing humming sounds. At the very beginning she stumbles because the mask she is wearing gets stuck in her mouth. Everyone including herself is laughing. She then starts singing again, reinforcing her voice and getting into a more professional mode – the sounds are powerful and mesmerising. Anna reacts to her singing manually moving the immobilized drone in the space. There is no simple connection between the pitch of Natalie's voice and the drone's movements but the interaction of Natalie and Anna looks like a coordinated performance. We are observing silently, there are no comments, everyone is immersed in the performance. We became an audience. The end of the performance is met by applause.

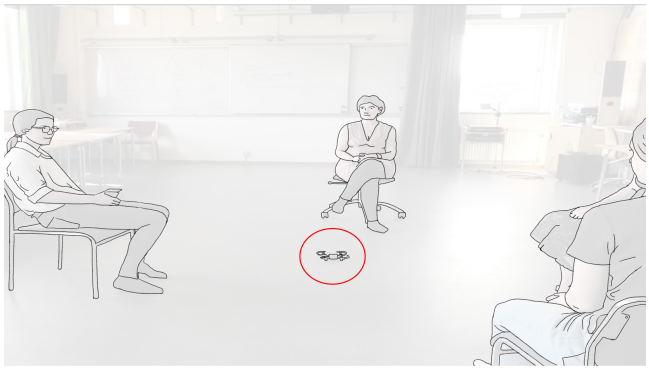

Figure 5: Olivia, Maxine, Natalie and Lena sit in a circle with the drone at the centre

We continued exploring sound as a way of interacting with the drone during later stages of our process. To stimulate the exploration, we staged it as a workshop *"Singing with the drone"*. We officially named the workshop, organized a dedicated space for it, and planned a series of exercises with rules, and arranged a leader with professional expertise in singing. We concluded the workshop with a discussion aimed at translating our playful insights into practical design outcomes. Such a framework made exposing ourselves to the unknown easier. At the stage in our design process when the workshop was organized, we had also started trusting each other more, which made engaging with the non-habitual significantly easier compared to our earlier work. However, the engagement still required a lot of interactional work to determine the boundaries within our exploration and create a safe space for experimentation.

We further consider interactional work performed as a part of the *'Snake'* exercise (See Figure 5). During the exercise, we gathered in a circle, the first-person produced a sound – a humming, low note, or a series of beats – and the next person listened and responded with a sound resembling the first in rhythm or tonality, to which the next participant responded in turn, repeating the cycle by producing a new variation of the sound. We used the sound of our TELLO drone as a starting point.

The seemingly silly action of imitating the drone's sound was intimidating and required work to establish the space where we could be playful without being judged or embarrassed, but also without being pushed beyond our personal limits. The interactional work included encouraging each other to remove unnecessary expectations: *'we'll try and we'll see, yeah, we'll do our best'*. There was no criticism over other members' mistakes and embarrassment,

and, in contrast with the beginning of our process, there was significantly less laughter. Self-laughter, in this case, did not make others laugh but prompted supportive gestures from other members. We encouraged each other to participate in the explorations, but avoided pushing beyond individual limits. We kept available and occasionally drew upon the mechanisms of resisting the engagement, such as laughter or taking a break from the activity. These are essential as engagement is not a one-off commitment, but needs to be constantly negotiated throughout the process.

5 DISCUSSION

In arguing for vulnerability as an ethical stance in soma design, we have highlighted it as a necessary but often neglected part of an exploratory design process and depicted the conditions of its emergence. In what follows, we first summarise our position on vulnerability in soma design and other first-person-based design approaches, explaining how this stance may connect with *felt* ethics. Our aim is to demonstrate that purposeful vulnerability serves as a necessary precondition for developing ethical sensibilities and reflecting on otherwise taken-for-granted ethical stances. We then describe *how* vulnerability can be cultivated in the course of a design process and reflect on the staging and ethical deliberation that this entails.

5.1 Vulnerability, ethics, and aesthetics in first-person design processes

Our results here pertain to a first-person design process [25] where the felt experience is guiding design choices. Through our work, we have come to see vulnerability as an *active* ethical position [65], a deliberate attitude where participants take the risk of exposing their weaknesses, putting themselves in a position where they depend on one another. Vulnerability, therefore, is the opposite of a passive non-action – it is an active move towards exploring the unknown. Purposeful vulnerability in design is required to fully engage with non-habitual actions, moving away from established norms and routines. While a first-person stance requires being vulnerable, vulnerability is not 'an automatic feature'. Instead, it is an interactional achievement that has to be orchestrated: Vulnerability – understood as taking a risk, exposing oneself, and resigning part of one's autonomy – is accomplished through collaborative work.

We recognise that vulnerability is not specific only to soma design, and that all creative processes feature some sort of vulnerability. Our notion of vulnerability resonates also with the skills required of good ethnographers who have to manage the discomfort often involved in entering previously unfamiliar social worlds, while striving to remain reflexive [5]. Approaches like sensory ethnography explicitly call for researchers to attune to their somas, too, in stressing how smell, taste, touch and vision can be interconnected and interrelated within research [46]. Despite these similarities, we argue that vulnerability is especially prominent in soma design's commitment to challenge the habitual and disrupt the normative.

The vignettes discussed in this paper are examples of vulnerability in a very specific context – a design process where vulnerability appeared through exposure to discomfort, embarrassment, and uncertainty of the process rather than structural reasons related to socioeconomic context. We realise that our examples are far from extreme. Emotional discomfort and physical vulnerability can be much more dangerous and have more serious implications, even in the academic context, when we deal with 'taboo' emotions: anger, disgust, jealousy, or power struggle. We discussed an example of a breakdown that got resolved quite successfully, but there are breakdowns that are outright impossible to repair. Our aim here was not to illustrate the sharpest cases (nor would we have had the data to do so) but rather to open up space for recognising and reflecting on vulnerability and its place in the very mundane details of design work.

In soma design, stepping outside the normative uses of a particular technology – as well as the norms of human behaviour – helps us to articulate and challenge norms and habits. These efforts are similar to the breaching experiments of early ethnomethodologists where the goal was to challenge the norms of ordinary communication in order to make them visible [17]. Here, however, the aim is not only to understand what the norms are but also to push past them in order to imagine and create new interactions. Soma design cultivates vulnerability actively as a design resource and purposefully provides space for reflection. Methodologically, it also demands designers to systematically examine, document and reflect on their inner experiences so as to influence design outcomes [26]. This makes the interactional work aimed at staging vulnerability more readily observable.

Our argument for vulnerability connects to both ethics and aesthetics. We work from the commitment that design needs to help us lead a better life, both as designers and as end-users of technology. In line with our soma-design position, we see better life as one that prioritises expressivity [13] and richer experience, sometimes through discomfort and risk [24]. As our analysis illustrates, breakdowns can be generative in that they open up a space for negotiating ethics. Breakdowns do not by necessity imply situations of physical risk; moral breakdowns can be 'out of ordinary' situations where following taken for granted norms is no longer possible [72]. Our three examples demonstrate that the moments of ethical choices are *felt* – they are moments of emotional tension and release. This was perhaps most apparent in the drone crash example, but it is also present in the moments of embarrassment and discomfort. As we have shown in our analysis, vulnerability involves risks, and risks should only be taken with care: creating space for being vulnerable goes hand in hand with creating space to deliberate on the ethics of our vulnerable encounters with each other and the technologies we engage with.

Just as aesthetic sensibilities are cultivated through engagement with our lived bodies in design practice [24, 53], our felt experience of vulnerability can lead us into reflection on our ethical micro-decisions and eventually help us cultivate an ethical understanding towards each other. This suggests to us that ethical sensibilities can be cultivated if we manage to build interactions where participants are open to their emotions and interactions with one another. This by necessity implies being vulnerable to exposure and discomfort. 'Ethical habits' – taken for granted ways of addressing oneself and each other – can be revealed and challenged if we manage to put ourselves in an authentic, honest, and vulnerable mode of interaction. Hence, we now turn to the issue of *how* we can cultivate vulnerability in the course of a design process.

5.2 How to cultivate vulnerability in soma design?

Adding to the growing discussion on micro-ethics [15, 56], we claim that ethics is not solely about making technology adhere to certain rules or checklists, but also about the design process itself: how we cultivate conditions that allow us to explore the unfamiliar and even the uncomfortable without harming each other. Expanding on care ethics [61], we consider all of us who work as designers within the first-person perspective as vulnerable and, thus, stress the importance of treating each other with care.

But what does it mean to cultivate vulnerability with a caring sensibility? A key aspect of this is how the interaction is staged: we strive to not harm each other, we work to give each other space to explore, and we make efforts to create safety without avoiding discomfort.

Soma design methods are specifically aimed at establishing openness within the group: The sharing that takes place with the help of body maps, which prompt participants to engage with their bodies but also open up and share their experiences with each other; the exercises that concern deliberate engagement with one's soma, and setting up playful explorations (see e.g. [63]) are all part of staging a setting that cultivates vulnerability in a generative manner. Similarly, engagement with digital materials and artefacts, such as drones, is important for producing a space of openness and experimentation as well as getting deeply acquainted with the materiality of the technology. Vulnerability and the risks associated with it were seen to arise in the assemblage of us and the drone, shaped not only by our connections to each other, but also in the dynamic unfolding of our collective interactions with technology.

Much of this interactional effort is situated in small decisions, such as when to push others to engage in the exploration more and when to allow others space to resist exposing themselves. These decisions are highly context-specific, and cannot be distilled into a set of instructions. In our case, mundane interactional decisions implied, for instance, allowing resistance in the form of laughter or self-distancing during the first sessions, or taking into account everyone's opinion on demonstrating the video of the crash, whether to disclose our real names, and trying to mitigate power imbalances in the design process.

To give a concrete example, we needed to discuss whether or not we can demonstrate the clip of the drone crash publicly. While watching the video within our group, laughing and discussing our actions created a bonding experience, showing the video to others, outside our group, increased the significance of the crash and came to threaten the trust within the group. The video, taken out of context, could easily be misinterpreted, for example, as a joke. As a part of this, we made the choice to apply pseudonyms throughout so that we do not need to reveal who is who, while still allowing us to convey our first-person perspectives and the work we have done together as a team. One conclusion, here, is that soma design teams need to discuss what kind vulnerability and related risks the team members are willing to accept – and be respectful of every team member's position on what they are willing to expose.

We have learnt that retaining space for resistance is important. Since being vulnerable in the presence of strangers is hard, resistance to exposing oneself will inevitably appear and should be accepted. For us, resistance often took the form of laughter. We struggled with laughter during the first sessions, where it accompanied all stages of exploration: we were laughing together, individually at ourselves, each other, and the activity. While resistance can be disruptive, keeping the possibility to step outside the deeply involved exploration is essential for building safety and comfort. The risk involved in being vulnerable should be taken voluntarily rather than imposed on anyone as a condition of being a part of a group. Resistance at the earlier stages of the process is to be expected, and suppressing it will only generate conflict.

While we cannot give more general instructions as vulnerability is not reducible to abstract principles, what we can say, following feminist theories [1] and critical pedagogies [11, 70], is that being vulnerable and open to change implies discomfort. Discomfort is an inevitable consequence of defamiliarisation, questioning our habitual ways of being and our taken-for-granted assumptions [70]. Discomfort should be reflected upon as it demonstrates where the non-problematic breaks. Additionally, personal discomfort asks for deeper engagements as a potential indicator of structural issues [1] – one could, for example, probe whether discomfort arises because one's agency has been hampered, one's habitual ways of behaving have been challenged, or because one's privilege has been questioned. In any case, being vulnerable implies questioning one's assumptions and opening up to the possibility of change. In summary, the task of developing ethical sensibilities requires exploring the underlying reasons for discomfort.

Soma design is a valuable approach to exploration as it provides instruments for reflecting on what is usually taken for granted. However, engagement with our feelings through soma design does not promise to solve ethical issues on its own. One of the reasons is that the feeling of discomfort is contextual and impartial. The sensibility to discomfort is mediated by our personal histories (which are inevitably intertwined with our social positions), expertise, and environments. For example, discomfort around a design decision can be felt by a person with a past experience of oppression while unnoticed by others. Some situations would make a trained physiotherapist uncomfortable, but would not be noticed by a layperson. Actions felt as entirely non-problematic at a university campus, might not be acceptable in another context. That means that if we design technology for others, we need to train our capacity for empathy and compassion as our end-users might have other sensitivities to discomfort. This said, exploring discomfort, its reasons, and ways to train a soma-based sensitivity to ethical issues, should be given further attention. What we learnt and reported here showed how the ethical work of changing our habitual ways of being cannot be done without engaging in purposefully vulnerable interaction with each other and the technology at hand.

6 CONCLUSION

We positioned vulnerability as an ethical stance in soma design and a necessary but often neglected part of an exploratory design process. We argued that purposeful vulnerability in design is an interactional achievement rather that an automatically emerging feature. Subsequently, we analysed the conditions of its emergence and what it renders. We also demonstrated that the state of being vulnerable opens up space for negotiating the processual ethics

of interaction design. The decision to engage in design with vulnerability requires members of design teams to treat each other with care, but being vulnerable allows us as designers to *feel* ethical decision-making as emotionally loaded moments of tension and release. This stimulates our understanding of ethics as processual, sensorial, and situated in the bodies of both designers and users of technology.

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