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The Body in Play: Dimensions of Embodiment in Design for Play

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ABSTRACT

This paper offers an analysis of how design activities engage with the body in the context of teaching embodied methods, and specifically body-centric design for play. Based on the analysis, we propose an empirically grounded framework for describing the various engagements with and considerations around the body as it comes into play in coursework on the use of body-centric design methods.

Under an overarching interest in dealing with use contexts and interactions as embodied and situated experiences, designers have been concerned with diverse issues, problems, aspects and opportunities related to the body. In interaction design and design-oriented HCI, this is reflected in a wealth of theories, design concepts, methodological frameworks and design examples that describe, explore and guide the design of body-technology relations. Much of such work has been of a normative character, recommending how design practice or designed things should relate to bodies, with an eye to method or design concept development. Few work has been concerned with how this interest can be implemented in design education, and how to teach students to attune themselves to bodies. In this paper, we apply an analytical, rather than normative, approach to body-centric methods, and one that is situated within the context of a specific area of interest for design practice, i.e. that of design for play. Through that, we focus on how distinct views of and approaches to body intersect in design activities, as they are carried out by students as part of coursework. The paper also contributes to embodied play design education by providing a body-centred framework.

Based on empirical data collected from project work carried out by design students on a master's course in product design, this paper offers an analysis of the students' engagements with and considerations of the body. We find five bodily dimensions: the physical body and its parts; the body as locus of action; the body as locus of embodied experience; the social body; the body as materially entangled – and one practice-specific dimension, the body in play. These findings are then described in the form of a matrix aimed at guiding design education.

*Both authors contributed equally to this research.

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CCS CONCEPTS

• **Human-centered computing** → **Interaction design process and methods**.

KEYWORDS

body-centered design, design for play, embodiment, design education

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1 INTRODUCTION

In design for play, the body appears as a central concern. Product design for play is often motivated in relation to the bodily well-being of players, either by supporting the sensory-motor and cognitive development of young children as well as adults, or by nudging them to engage in healthy physical activities [3], or by protecting them from potential physical harm during play [52]. Additionally, embodied interactions play a significant role in the design of interactive artifacts for play, for example by tracking the movements of the body, then providing sensorial input that invites users to engage their bodies in play [13, 38, 39, 41]. These reflect larger designerly interest in the body: From everyday objects to smartphone applications on to assistive technologies designed things engage the bodily capabilities of users from walking to breathing [5, 7, 8], monitor physiological processes from pulse to brain waves [45, 55], augment bodily potentials [40], for example by enabling users to use their physical body to manipulate digital content [37, 39] , and/or extend their sensory capacities, for example by making immaterial phenomena more visible, audible, even tangible [1].

Accordingly, concerns for bodily movement, embodied experience and creativity have been addressed in design research from a wealth of theories, design concepts, methodological frameworks and design examples that describe, explore and guide the design of body-technology relations – such as embodied interaction [10, 11, 14, 44], soma design [22, 23, 59] and design for tangible user interaction [18, 26]. Such work have laid the theoretical and conceptual foundations for placing the body at the centre of our understanding of both use contexts and design activities – e.g. by offering philosophical footing for understanding body-technology relationships [57], developing design concepts for body-centric design [24, 48], developing methods and methodological approaches [41, 58, 61]. A

number of influential papers have reviewed these from various perspectives [16, 35, 53, 58, 61], yet sharing a normative position that advocates more holistic inclusion of bodies in design. We summarize and discuss some of these reviews separately below. This paper differs from existing accounts by considering body-centric design from an analytical perspective, and from within an educational context. Specifically, we are interested in how body-centric design methods attune students to different aspects of the body (such as specific body parts, embodied experiences, movements, and bodily processes) so that they can make sense of those as both means and objects of design intervention. To gain an understanding of this, we analyze empirical material from a design course on bodies in play. Our study is largely placed in the context of design for play, and therefore takes embodiment within the context of a specific area of design practice. As such, we also contribute to teaching design for play by providing a body-centred design framework for that field.

Below we start with a review of related work, followed by a presentation of method and our analysis, which indicates five dimensions of body in design: the physical body and its parts; the body as locus of action; the body as locus of embodied experience; the social body; the body as materially entangled – and one practice-specific dimension, the body in play. Finally we propose a theoretical framework in the form of a matrix that highlights the intersections of the dimensions, accompanied with suggestions as to how it can be used to study and guide design education activities.

2 RELATED WORK

Body-centred design has emerged through the study of use as situated and embodied experience and the turn to Merleau-Ponty's phenomenology for that purpose [10, 46, 56]. This led to a proliferation of embodied perspectives, with emergent interest in skills in tangible interaction [9, 26], movement and sensation in kinesthetic interaction [19, 31, 32, 57], as well as increased experimentation with embodied and first-person design methods [21, 23, 58, 60, 61].

Existing reviews have summarized these developments. Reviewing research from HCI and other relevant disciplines, Loke & Robertson [35] found six different concepts of the body present in the literature. The concepts include the body as anatomy and physiology, body as expression, body as knowledge, body as felt experience, body as physical skill, and finally the social body. More recently, Homewood et al. [16] observed three 'moves' in how body-centric HCI understands and engages with bodies: from 'user to body' describes a first step towards conceptualizing the user as a corporeal subject; a second move from 'body to bodies' describes a more recent understanding of bodies as plural, which refers to diversity as well as a disintegration of the holistic body into distinct quantifiable data points. Finally, 'from bodies to more than human bodies' indicates an emerging push towards accounting for the socio-material entanglements of bodies. The third move described by Homewood et al. follows recent trends in the emerging so-called 'fourth wave' HCI that draws on insights from Science and Technology Studies, especially feminist STS. This can be compared to Spiel's [53] feminist content analysis of the norms and assumptions about the body that underlie existing research on embodied interaction. Spiel finds that gender norms nevertheless remain mostly unchanged, as the dominant approach still refers to users as either singular, possessing idealized bodies, or as completely disembodied agents. Other reviews related to bodies and embodiment in design include Wilde et al.'s [61] review of design methods for embodied ideation, where the body plays a crucial role not only as the object of design, but rather as a facilitator of the ideation process, and as a mediator of tacit knowledge. A similar example is found in Svanæs & Barkhuus [58], where the authors categorize methods in terms of perspective – from methods utilizing designers' own embodied experience to empathic participant observation on to observations of the objective body – and in terms of tense – including methods inquiring into the past, explorations of the here-and-now and speculations about the future.

As this brief discussion shows, bodies have been central to interaction design and design-oriented HCI over the last two decades, taken up by research in a range of different ways. These reviews have a classificatory focus, acknowledging and describing the diversity of approaches, while also calling for the design field to address embodiment more extensively as well as more comprehensively. This paper aims to demonstrate how this call for a diverse understanding of the body can be brought about in design education. Our approach is analytical rather than classificatory, as our interest is on how different ways to think about and engage bodies in design cross-cut and converge, rather than isolating theoretical and methodological strands or promoting one over the others. We therefore offer an empirical study of the work of design students with the aim to explore how the students gained an understanding and practiced an engagement with bodies, and how this is facilitated through the practical activities undertaken as part of coursework. To our knowledge, there is little work concerned with teaching body-centric design. A notable example is Tsaknaki et al.'s [59] report on curriculum designed to teach soma design to design students. In a seven-week course the authors introduced students to various body-centric exercises such as Feldenkrais, Seesaw breathing and contact improvisation, which aimed at familiarizing students with their embodied experience and bodily relationships with other bodies; and guided them through the development of a final design concept. Tsaknaki et al.'s report introduces the course activities and evaluate the soma potential of the students' final designs. While the current study is also carried out in an educational setting and collects data from student work, we are not primarily concerned with the quality of the prototypes and concepts designed by students. Instead, our focus is on the students' design process, and how the activities carried out as part of the coursework attuned them to the diversity of the body in play.

Our specific focus on play also calls for a brief discussion of how the body have been treated in academic research on play and play design. Not unlike the idea of the entangled body mentioned by Homewood et al. [16], game researchers have theorized the bodies of mostly computer game players as cyborg-like techno-corporeal configurations of human flesh, hardware and software [12, 29]. In HCI, a similar understanding of the body in play has been promoted by Spiel and Gerling [54], who also consider how the configurations of technical apparatus and bodies can be used by designers to elicit affective responses in the player. However, although the computer makes entangled relationship between bodies and materials very explicit, it is not only a feature of computerized play.

Drawing on new materialism [2], play researchers have theorized play as a mode of being in which we relate to objects, others and the world and their particular agencies. When we, for example, relate to a wooden stick in a playful mode, the stick becomes a toy that qua its specific materiality afford play in a certain way [50, 51]. As such, play is not something we do to objects, but rather with them [47]. A similar idea is promoted by Gudiksen [15] who stressed that the design of toys, equipment and experiences of play must structure play while still remaining open to meanings that emerge when play unfolds. Bodies can be considered similarly, so that, in play, the body becomes constituted by the materialities and other bodies that it relates to in a playful manner. This might be what Mueller et al. [38] mean with their idea of the body as play. According to the authors, much designerly engagement with the body is characterized by a limited understanding of the body as either an extended control interface for the player's interaction with the gaming technology (enabled by the application of sensor technology into gaming hardware) or as an object for therapeutic intervention through games specifically designed to improve the physical health of players. Drawing on insights from soma-design among other areas, the authors instead propose a distinction between the physical and experiential body (*körper* and *leib*) and argues for a vision of play design which considers both the physical and experiential body. Drawing on this work Matjeka and Mueller [36] propose using the distinction between playing and gaming to signify different modes of bodily engagement. In their work playing involves the body in an manner that favors perceptual stimulation and exploration, whereas bodily engagement in gaming is about skill and achievement.

3 COURSEWORK

The results presented in this paper are based on two sets of sources. The first is a two-week course module, "Body in Play," offered at the first semester of a master's program in product design. The objective of the module is for the students to learn about, practice with, utilize in a short project, then formally reflect on diverse body-centric design methods and activities. The first week introduced students to different design methods through the activities described in table 1. The activities were chosen to represent both different approaches for addressing embodiment in HCI and interaction design (e.g. movement-based, self-reflective and ethnographic), and the diversity of design process stages in which bodies matter (research, problem definition, ideation). At the second week, the students worked in teams on a brief final project, with the following brief: "You are at the playground. One of you doesn't want to play. Design a play experience and/or a play thing that will get them to play." It was up to the teams to build on the first week activities to define a problem, develop a prototype and present it in three days. At the end of the module, the students were asked to hand in a reflective essay. The second author of this paper had the teaching and grading responsibilities, whereas the first author participated mainly as a researcher, and played a minor role in teaching. The first author collected data throughout the process, as described in the next section. Table 1 offers an overview of the course activities with instructed methods, their associated learning activities, as well as references to relevant literature.

The following semester, the same cohort of students took part in a five-week project-based course, where they developed their own design projects with the brief "to facilitate shared making." The course emphasized both the bodily and collaborative aspects of making, and the students were encouraged to use their own bodies in a curious and exploratory manner to identify design opportunities in the form of shared embodied experiences. The course schedule involved first-person and second-person research activities, in which students investigated the process of learning new skills, such as knitting and dancing. Fieldwork was iteratively followed by ideation and prototyping activities, as each team developed their own project. The second author was a co-tutor of the course; the course activities were not designed with an eye to research, and data was collected after the projects were completed via interviews, as described in the following section.

4 METHOD

4.1 Data collection

As mentioned, the aim of this study is to understand how the students attuned themselves to and engaged with the body in play during the two courses. To gain insight into this issue, we collected empirical material that reflected the students' experiences with the different activities they participated in during the two courses.

During the first course, the first author made observations, while in-class activities were recorded, including class discussions where students reflected on specific methods. Together with the reflective essays, the transcriptions of in-class conversations and presentations constitute the first corpus of materials included for analysis. 22 students in total were registered as students on the course, whereas we used the data from the 14 students, who gave their consent for inclusion in the study. We discuss research ethics in a separate section below. The sample of participants included 10 different nationalities, both European and overseas. 71% were women, and participants came from diverse educational backgrounds from Business, Marketing and Communication to Anthropology.

The second corpus constituted interviews with selected students from the second course. Participants were selected for interviews based on the criteria that there was a playful dimension to their projects, and that they have employed some of the methods they had learnt in the previous two-week module on designing for bodily play. Interviews were carried out by the first author, after the participants had completed both courses, and lasted 30-50 minutes, inquiring into the different activities that the students had carried out as part of the design process, and how these informed their final projects. Four interviews were conducted in total, involving 8 students, seven of which were female. This sample included 6 different nationalities from diverse educational backgrounds.

Both data corpora largely consist of student's own descriptions of and reflections on their experiences with different design activities, including results and findings from exploratory and evaluative activities, the material they generated, and the issues they struggled with. In addition to this, we also included visual material such as drawings, photographs and video clips of different activities and prototypes.

Table 1: Course activities, their learning objectives and relevant literature

Course activities	Learning objectives	Key references
Playground observations from 1st, 2nd and 3rd person perspectives	To gain insights on the context and use of playground equipment	Svanæs & Barkhuus [58]
Making body maps of students' own experience of playing a game involving the whole body	To explore and notate embodied experiences	Cochrane et al. [6]; Vidal et al. [30]
Making and enacting use scenarios	Gaining insights and communicating context and use of design solutions	Schleicher et al. [49]
Playful embodied sketching, with elements of estrangement	To sketch interactions and explore design solutions	Márquez Segura et al. [41]; Wilde et al.[61]

4.2 Analysis

The aim of the analysis was first to gain insights into students' interest in diverse aspects of the body, as expressed in the collected material, and secondly to understand whether and how the interest was translated into specific design opportunities and considerations. All material was analyzed on Nvivo by the first author of this paper.

An initial analysis of the material was conducted in a manner inspired by Grounded Theory, where codes were induced from the material itself, although also based on the overall focus on the body and play. After having gained an initial understanding of the material, a second constructivist, thematic analysis of the corpus of materials [4] was carried out. Thematic analysis is an interpretive analysis that aims to find thematic patterns in the data guided by a research question. In this case, the analysis was guided by the loosely formulated question of how students understood and engaged with the body. In this second round of analysis, codes were grouped into six thematic dimensions, which will be discussed in the next section. It is important to stress the interpretive nature of the analysis: The themes identified were not explicitly expressed in the data, but emerged through an analytical process of interpretation and abstraction [33] which took place as codes and excerpts from the data were compared. Furthermore, the dimensions were not mutually exclusive, and codes could therefore belong to several dimensions at the same time. Finally, after having identified the six dimensions, we returned to the initial codes to refine them.

For example, if a student described how she considered the movement of fingers when performing some task, such as knitting, this was initially coded as "use of fingers" and "knitting", but interpreted as an interest in the "physical body" (the fingers) and the "active body" (how they performed the task). Finally, revisiting the data excerpts of the initial codes, these would be refined into "fingers," "skills," "usefulness," and "uselessness" (for example if the student described how some fingers were used and others not), and so forth.

4.3 Ethics

Although participation in the course was mandatory for students, participation in the study was voluntary. On the first day of the course on "body in play", students were briefed about the study and informed that we would record and document class sessions for analytical purposes. Students were also given the opportunity to decline participation in data collection. None of the present students opted out. After the course ended, but before the analysis was initiated, students were asked for written consent. 8 out of 22 did not give consent. The class setting made it difficult to completely remove all collected material concerning a non-consenting student (such as when this student was present in class in an audio recording of an in-class session of shared reflection). In this case, the material would be kept in collection, but any statements and comments made by the student would not be subject to analysis. The analyst was not involved in the grading of the course.

With regards to the interviews with students that took part in the second course, these were carried out after the students had completed the course and received their grades. The interviews was done by the first author of this paper, who had not been involved in teaching or grading. Before the interviews, students who participated in the interviews were asked for written consent, and informed that the subject of the interviews were not their performance in class or the quality of their projects, but rather their experience with the different body-centred design methods.

5 FINDINGS

The source material revealed a wealth of different dimensions as to how bodies were referred to and involved in the students' design processes. In the following, we present six main dimensions of the students' engagement with bodies. The first five are generic, while the last is specific to play. Note that these dimensions are not mutually exclusive but intersect in various ways in the students' work, as will be discussed in the following.

5.1 The physical body and its parts

This dimension refers to considerations of the body as a physical form or a material structure comprising different body parts. These include considerations of the size of the body and its parts vis-à-vis other physical forms, as in one student's first-person observations that playground structures restricted access to larger bodies. Reflecting on their experience with making body maps, students described how they wanted to visualize what body parts they had used to carry out a task, as well as which parts were surprisingly not used. The physical body also played a central role in prototyping exercises. One student who was part of a team that prototyped a large game board for disabled kids, described how they realized, during

a quick testing of the game board, that it would be difficult to reach all areas of the board from a wheelchair.

Figure 1: Head-worn interactive ears tracking and responding to the pulse of the wearer.

Another example is from a team of students that were concerned with improving the quality of teamwork with an intervention into the affective dimension of collaboration, for whom physical body became both a barrier and a source of inspiration. The team who had built their prototype of an interactive necklace on a headless mannequin, tested it on a human model and realized that it was too small to go over the head. Students describe this initial failure to consider the physical dimensions of a human head as a pivot of their project as it inspired them to change their idea to a head-worn wearable with interactive ears (see Figure 1). This required them to consider additional issues related to the physical body and its limitations. For example, when worn on the head as opposed to around the neck, the interactive piece would be positioned so that it would no longer be seen by the user herself, but only by other people, which in turn prompted the students to change the functionality of the product: While originally the product communicated the qualities of the "external" environment (air quality) to the wearer, it could now communicate "internal" qualities of the wearer to others in the environment. The students' solution was to use the wearer's pulse as an indicator of the wearer's affective state, namely level of agitation, which would then be communicated via the interactive headset.

5.2 The body as locus of action

This dimension is also related to the physical body, but emphasizes skills, bodily capabilities, concrete object interactions, and other activities carried out with the body. In the empirical material, this dimension was reflected in descriptions of a variety of observations carried out by students. These include general observations of playground behavior, how children interacted with equipment and how the equipment in turn afforded certain intended and unintended actions. In their discussion of their body maps, students also described how specific parts of their bodies felt useful, or useless and "in the way", during the play sessions that they analyzed: One student for example observed: "I used my knees because I felt that the knees are more, like, sensitive." Other students reflected: "I was quite surprised why I didn't use my feet (…)," whereas a third student explained that she found it difficult to control her legs, and therefore she did not use them much.

This dimension was particularly prominent in students' reflections on their sketching and prototyping activities. The activities display an interest in the active body as students for example explored different ways to increase the difficulty of certain playful activities by tying together legs, increasing the resistance of materials, or by completing tasks using other body parts than usual, as showcased in Figure 2. One team worked with removing bodily skills from users, and explored, among other things, painting with a large brush that was attached to the back, thus forcing them to translate fine motor skills of painting into gross motor skills that involved the entire body, effectively making them re-learn how to use a paint brush.

Figure 2: Two students experiment with making ordinary bodily activities such as hopscotch more difficult by tying their legs together.

5.3 The body as locus of embodied experience

This dimension refers to the felt experience; bodily experiences such as perception, sensations, emotional experiences, affect and aesthetics. It was prominently expressed across the students' entire design processes in both courses. For instance, as the students talked about their own experiences with learning new skills, emotional experiences were frequently mentioned: One team reflected on how two different bodily activities (dancing and origami folding) entailed distinct concerns. In the former, students felt aware of their bodies and its movements as a medium of expression and the center of attention, whereas in the latter, the body became more of a tool as their own attention was directed towards the paper they folded. Students also reflected on the quality of their affective or emotional experiences. In their presentation of their body maps one student described how moving her body with eyes closed made her feel dizzy and motion sick (see Figure 3). Two students reflected on how it felt being touched on their back: "I like when our (…) back is touched, it felt like warm and, you know, kind of cozy" and "but as [a teammate] passed behind my back, I felt kind of comforted". Likewise, students would also report on less positive experiences such as "I was balancing on one leg, so I kind of felt like off balance

here, and there was like a little bit of pain in the calf" and "I have a sensitive neck and maybe head as well, so the feeling of, like, rubbing my head against someone (…) it's not comfortable".

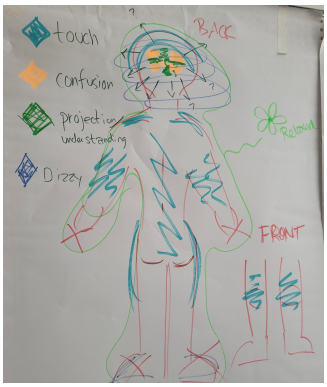

Figure 3: A body map visualizing a range of embodied experiences from a bodily play experience.

This dimension could also be found in descriptions of their own experiences with interacting with objects and materials: "(a)nother part of the playground had a tube labyrinth where one could go in and lose a sense of direction (…) (w)hile at the same time providing a sense of solitude, as [the] perception of who is inhabiting the same space was blurred". A similar attunement to the experience of material interaction occurred in an embodied sketching exercise. A group of students explored how to add sensorial experiences to existing playground equipment, and, drawing on a childhood memory of sliding down a staircase as a child, they came up with the idea of adding a rumble sensation to a slide.

5.4 The social body

This dimension refers to considerations of the body as a participant in a social relation. Such considerations can concern the communicative aspects of the body, such as body-language and gestures, behavior that is conventionalized or appear as unconventional, as well as social contact such as touching, caressing, hitting and so forth. A frequent concern mentioned by the students in their presentations of body maps following a play session was about how they were careful not to make the others uncomfortable. One student for example visualized their "no-no squares," indicating body parts where they did not wish to be touched. Another described: "because I'm a little bit bigger than her [the student she was playing with], I was thinking I cannot use my upper body because if I felt I'm going to hurt her (…) So, for me, it was just, like, trying to make the other person feel safe."

Under the dimension of the social body we also include considerations of presentation of one's body to others. In the presentation of their body map, one student described how they were conscious about their own bodily odor when playing with another student. The body map exercise also gave students insights into how playing had been experienced by the person who they had been playing with, as one student nicely put it: "Now seeing her [the co-player] drawing herself [and] what she felt is a little bit… like… I can see how I make people feel by my actions, so I think it's a nice way of looking [at the situation] (…) it's not necessarily like… thinking about yourself but thinking how the other person felt."

Figure 4: A student explores whether shadows can create a sense of social togetherness.

In relation to design aims, most of the projects that students were working with in either course aimed to solve some social problem or modify a social relation, e.g., in the context of loneliness and social exclusion, how to work better together towards a common aim, and so forth. In these projects students typically explored the ways in which materials and things could facilitate and mediate social relations. One team working on a project about loneliness explored how shadows of one's body in motion might evoke a sense of being surrounded by other bodies (Figure 4). In one feedback session, students commented on a team's scenario of an interactive museum exhibition by arguing that the exhibition could be designed to remove the sense of intimidation that may arise in social situations by focusing the attention of museum goers at the interactive objects rather than at each other.

5.5 The body as materially entangled

This dimension is related to considerations about how the body is entangled with other things, with an emphasis on relational qualities, including agency and co-constitution. Included in this dimension are design considerations such as accessibility of objects and equipment, considerations of control, safety, affordances, and types of use. This perspective was central to the embodied sketching exercise, in which students explored how assorted materials and objects afforded play. One team explored how a plastic mesh could be used to impair vision as a game mechanic in a game of hide and seek. Several students described experiences of estrangement – how their interactions enabled them to experience their bodies differently, where this renewed awareness was instrumentalized to control the material (rather than the body itself, as in the theme "body as locus of embodied experience") (Figure 5). Students also identified how this could be conversely utilized to make people less self-aware in social situations. On the other hand, the exercise also entailed a sense of responsibility over handling the material carefully, e.g. to avoid damage. Student reflections in the following class discussion on material entanglement focused on how objects also afforded unforeseen and unwelcome uses. In their field observations on playgrounds, too, the students commented on equipment that might pose a safety risk to players, along with how materials such as handrails and shielding would mitigate such risks for only some (shorter) bodies and not others. Similarly, one team who had developed a scenario for a vertical pound-a-peg, where players could punch pegs into a big wall, discussed how pegs needed to be quite

sturdy to afford punching, but also how that might invite other activities such as climbing, and whether that was then welcome or not.

Figure 5: In an early prototype of a collaborative game, students are exploring ways to control a large paint brush attached to their backs.

5.6 The body as play

This dimension refers to considerations of the body as an agent in play. Although this dimension is intimately related to the other dimensions, it specifically concerns instances where play modifies how the body is used, experienced and enters relations with objects, materials as well as other bodies. Included in this dimension are reflections on how play is signaled and instantiated, playful modes of relating to other bodies, and how materialities afford and structure playful bodily interactions.

In one case, the students' reflections on the interactive headpiece described above included how the object produced a sense of playfulness in the user, which then made the user adopt a more positive, welcoming manner towards others. Having tested the headpiece in public space, the students were disappointed that people on the street did not respond to the headpiece, as if they did not accept the invitation to play that was signaled by the wearer. Another team who worked with ideas for playground equipment for children with leg impairment discussed how to create play experiences that would include the wheelchair, as an extension of the players body that is meaningfully integrated into play, instead of simply having play revolve around the wheelchair. The group of students who experimented with painting with a large brush strapped to their backs, described that their setup worked best when there was a goal that needed to be fulfilled. This goal would make participants of the students' tests more likely enter a playful state where they would collaboratively explore the experience. Lastly, in the discussion following the body maps exercise, one student described how she lost a sense of self when she was deeply engaged in the game, which in turn made introspection difficult: "I didn't feel much at the moment. I was just laughing, [it was] really fun (…) and I totally forgot about the exercise… to feel my body and pay attention to the emotions I have, because I didn't really… I was just concentrated. I was just really focused on [the game]."

6 PROPOSED FRAMEWORK

As the six dimensions introduced above show, body-centred design methods invite design students to treat the body not as a monolithic entity, but engage with it in a nuanced manner, as recent design-oriented HCI has advocated for. The dimensions described above

Physical body and its parts						
Body as a locus of action	Capabilities, skills, usefulness/ uselessnes of body parts.					
Body as a locus of embodied experience	Sensory experiences (local and general), bodily processes as traces of affective states.	Kinesthetics, Vertigo, dizziness.				
Social body	Bodily contact and touch, others impression of your body.	Body language and gestures, transgressive behavior, care.	Affective experience of social contact, trust, embarassment, empathy and responsibitlity.			
Body as materially entangled	Size and dimensions of equipment, accessibility, harm and safety, bodily augmentation and extension, tracing bodily processes.	Afforded interactions, right and wrong use, sturdiness, sensing bodily activities.	Affective experiences of objects and materials (aesthetics).	Control and shared use, mediating social relations.		
Body in play	Play as instrument for physical activity, bodily development and maintenance of health.	Goal-oriented play, exploratative play, role-play.	Emotional states such as flow, pleasure, excitement, comfort and discomfort, stress and boredom occurind during play.	Inclusivity, inviting into or excluding from play, collaboration and competition.	Affordances for play, props, mediating and facilitating and augmenting play.	
	Physical body and its parts	**Body as a locus of action**	**Body as a locus of embodied experience**	**Social body**	**Body as materially entangled**	**Body in play**

Figure 6: Key design considerations brought out by the correlation between the six dimensions

resonates strongly with both several of the categories proposed by Loke and Robertson [35], as well as the developments in HCI outlined by Homewood et al.[16].

Furthermore, as mentioned earlier, our analysis is not only intended to uncover which aspects of the body students were interested in, but also how this interest was made manifest in the form of specific practical concerns and design considerations. Like the six dimensions, these considerations were abstracted from the collected data through thematic analysis: When a student, for example, described their efforts not to touch certain areas of the body of a fellow student, this was coded as "transgressive behavior." One of our significant findings is that body-centric design activities led the students to negotiate amongst a range of conceptualizations of and concerns for the body that we categorize above in six different dimensions. What is notable is that attention was seldom given to these aspects in isolation. Instead, they were considered in relation to each other.

Building on empirical material, Figure 6 presents an overview of how the six dimensions relate to one another, calling forth specific design considerations that are of relevance to the design of playful experiences and artifacts. In the figure, the six dimensions are shown as variables on a matrix, where each intersection presents examples of considerations that were identified in the empirical material. The figure thus demonstrates the interactions among the six dimensions: Consider how the dimension "body as a locus of action" points towards differing design considerations when it is placed in relation with each of the five other dimensions: Approaching the

body in action in terms of "physical body and its parts" manifests considerations as to how and what parts of the physical body takes part in the action, and what bodily capabilities or skills are involved. Relating the same dimension to "embodied experience" brings about design considerations related to the experiential qualities of action such as the sensation of motion or bodily activities, whereas the dimensions of "social body" and "body in play" indicates the social and playful functions of bodily activities.

The figure thus represents an in-depth visualization of the results of our analysis. We further suggest that it can be used in design education to keep track of how different embodied design methods and activities enable students to engage with the (playing) body in ways that appreciate the nuanced and diverse quality of the body. For example, design educators may use the framework to structure students' inquiries of and engagements with bodies, both their own and those of others, and as such identify focal points and gaps. Alternatively, students may be asked to fill in the empty matrix as a tool for reflecting on their practice and/or design outputs. The framework can also be used as a generative tool, e.g. for ideation, by proposing design ideas targeted at specific intersections of bodily dimensions.

7 DISCUSSION

7.1 The framework

The framework presented in Figure 6 contributes to existing categorizations of the body in interaction design with a specific focus on the interrelations between different perspectives on the body. Whereas existing categorizations tend to treat the different bodily categories as either distinct [35] or as steps of an ongoing transformation in embodied design research [16], in our framework the bodily dimensions co-exist and intersect in the design activities through concrete design considerations. In addition, our framework adds an area-specific dimension, "the body in play," and shows both how this dimension may be related to the generic dimensions of the body in design, and how it yields play-specific considerations. By doing this, the framework also contributes specifically to the area of play design, as will be discussed in detail later.

Observing the students' relationship to real and hypothetical bodies in their activities and projects, has also provided us with insights into not only the intersections, but also the productive clashes between the concerns and conceptualizations each dimension points toward. As we discuss above, one of these was about the intended focus in design outcomes – whether a playful design should bring focus into one's own body or move that (sometimes unwanted) focus elsewhere – the difference between ready-to-hand and present-at-body [42]. Similarly, estrangement exercises can move the focus either on the experience of one's body or on the experience – and control – of the material [61]. Or a focus on physical bodies would be countered with care and responsibility to others and the environment during the activities as well as with an eye to future users [27], as encouraged by affective and social dimensions of the body. In resolving such conflicts, students' preferences were goal-focused, scaffolded by either the requirements of designing for play, or by the specific project they were working on.

7.2 Body-centred methods in design education

As a second point, the students' engagement with the body was structured by the specific design activities and methods; that is, different activities highlighted different dimensions and considerations. In Table 2 we evaluate the four core design activities in the first course, how they generated insights into the different bodily dimensions, and finally how our findings contribute to existing literature on these activities and methods.

First-person observations [20] about the designer's own body and its relation to the physical environment were useful in situated activities. However, obtaining an embodied understanding of other people through second-person observations proved more difficult, and likely due to the relative difference between the adult design students and the child players they were sometimes empathizing with. This suggests that second-person observations benefit from being supplemented with methods for extrapolating from the designer´s own experience to the users. Body maps, on the other hand, assumed a central role in expanding and making explicit all six dimensions, being especially useful in sensitizing the students to affective and social components of interaction. They prompted students to reflect on specific design considerations such as the sensory qualities of interacting with another person, as well as the experiences such as anxiety, trust, stress, and pleasure that arise from such social encounters. In addition, the class discussion of the maps also allowed students to get insight into the embodied experiences of others. In this, our findings expand on recent literature on body maps that indicate the diverse uses of body maps, including their use to visualize social interactions [6, 30]. We add to the usefulness of body maps in design educational settings, especially when used in conjunction with other methods, body-centred or otherwise, in fostering somatic connoisseurship [22, 34, 48]. The making and enactment of scenarios proved to be a useful method for generating a shared understanding of the social and material context of activities, especially in cases where the scenarios involved a degree of improvisation. This confirms Schleicher et al.[49], who describe embodied storming as an explorative pre-ideation method. Our findings suggest that hosting an in-class reflective session after each scenario enabled students to explore the scenario further, and also played a key role in fostering shared understanding. Regular physical prototyping as well as embodied sketching exercises were particularly useful in making students reflect on movement and skill issues. The latter facilitated engagement with how the body is materially entangled, and directed the students' attention towards the agencies and affordances of materials, including how they could augment or subvert different bodily capabilities and skills.

It should be noted that the two courses from which data is collected were taught with a studio-based approach where tutors introduced and guided the students through the different activities. In addition, the tutors would give feedback and engage actively in class discussions and physically in the activities. This means that the students' insights about the body are not only a product of the above design methods, but also a result of the tutors' framing of these methods, and how they guided and gave feedback to students.

Table 2: Course activities their learning objectives and relevant literature

Course activities	Insights generated from activities	Contributions to literature
Playground observations from 1st, 2nd and 3rd person perspectives [58]	*The physical body* and its relation to the physical environment *(body as materially entangled)*. In the case of 1st person methods: the felt experience of play *(body as locus of embodied experience* and *body as play)*	Awareness of the designer's own body, requires supplementary methods for extrapolating to future users
Making body maps of students' own play experience [6, 30]	*The body as locus of embodied experience*: The felt experience of interaction with another *(social body)*; embodied experience of others	Fostering somatic connoisourship and bringing attention to the experience of social encounters
Making and enacting use scenarios [49]	*The social body*: Social configuration of context of use, unforeseen affordances of objects *(body as materially entangled)*	Loosely structured scenarios in class as pre-ideation to explore the social and material context of an activity
Playful embodied sketching [41]	*The body as materially entangled, body in play*, affordances and agencies of objects and how they can modify bodily skills *(body as locus of action)*	Making students reflect on movements and skills

7.3 Bodies and Diversity

In earlier work [27] we described design work as a dual material arrangement in which designers enter into specific relationships with objects and beings in the immediate design context but also extrapolates and scripts this work onto a future arrangement of users and designed artifacts. Arising from this is a tension between the designer's own body and the bodies of future users. This tension was clearly reflected in the students' design work. Their first-person engagements with their own bodies in different activities and projects were highly specific in insights, concrete in language, and careful towards differences in bodies and individual boundaries. However, the users' body was still treated in a relatively abstract manner, thus confirming Spiel's [53] critique of designers' disembodied engagement with the body. One example can be found in the work of one team that was unable to explore what it means to live – and play – with the leg impairment disability they chose to focus on: The final solution proposed by the students was a large game board in which all children – leg-impaired or not – would be playing in a sitting position, thus virtually "leveling the playing field" for the children, but also reproducing a normative view of the body, in which differently abled bodies were rendered invisible. Besides the short time frame for the projects, as well as the lack of co-design components, which made it unrealistic to expect the students to explore other bodies in sufficient depth, it was made clear to us as tutors and researchers that, whilst body-centered methods made it possible for the students to explore diverse dimensions of the body effectively, they also made it difficult for them to separate their first-person bodily experiences from those of future users, often leading to problematic extrapolations from the activities here and now onto potential use settings in the future.

7.4 Play

As a final point, this study sheds light on the playful dimensions of design. Although existing studies have considered how to design games and play experiences that involve the body in meaningful ways [13, 38, 39], the students that took part in this study were not only designing *for* play, but also *with* play by engaging with their own bodies and the bodies of others in a playful manner. This is in line with Márquez Segura et al. [41] who propose to use play as a design method, and Jørgensen and Wirman [28] who in the context of design for interspecies play argue that playing with their users enable designers to address questions of differences in play. In the current study, the students adopted a playful mode of work throughout the whole design process, from pre-ideation and background research, to sketching, prototyping and testing. This enabled the students to discover aspects of play that they would then translate and transfer to their design solutions. This is not unlike the first-person methods used in soma design [17, 43]. However, where these works tend to emphasize the embodied experience and understanding of one's own body, we suggest that play, as a sociomaterial entanglement, sensitizes designers to connect with other bodies and materials. Although, as described above, the student would often conflate their own first-bodily experience with the future user's, they were nevertheless able to relate to the bodily experiences of their co-players in a nuanced and reflective way. Similarly, students were not only considerate of how objects and materials affected their own embodied experience of interaction, but also how their bodies might affect the materials. In their embodied sketching and prototyping activities, students would get a direct understanding of the fragility of the objects and materials they played with, and how to handle them with care, as well as how these materials facilitated and mediated playful social interactions.

8 LIMITATIONS AND FUTURE WORK

Our study has indicated that there is merit in looking into design activities empirically to identify the overlaps, intersections and tensions in the messy ways designers engage with bodies to solve the problems they formulate and/or encounter. However, as the study is limited to student work carried out within one context,

more work is needed to understand the role of specific design methods in facilitating and supporting design students' engagements with the different body-related concerns and concepts presented in the matrix in figure 6. Design educators may also benefit from distinctions in relation to the employment of methods in specific design stages, and from indications related to issues of diversity and representation, including specific guidelines as to how and to what extent designers' and participants' bodily experiences can be extrapolated to future users. The current case presents limitations in that respect by not having included co-design activities, as well as more recent takes on bodily experience, including introspection tasks and exploration of internal physiological processes [17, 25, 43]. Regardless, the method framework for body-centric design proposed by Svanæs and Barkhuus [58] provides a useful starting point for such work.

9 CONCLUSION

In this study we have analyzed instances of practical design work carried out in the context of a master's program in product design to document the bodily engagements and body-related considerations that emerge in designing for play. We identified six dimensions of the body: five generic dimensions and one area-specific dimension related to play. The generic dimensions expand on existing categorizations in literature, and a new dimension is proposed, which is related to sociomateriality, in line with recent calls to more-than-human considerations in design research. Our analysis and the resultant matrix of considerations furthermore put emphasis on how the different dimensions intersect. This study thus contributes to the literature on embodied design education, where it offers a framework that can prove useful to educators for bringing body-centric design into the design studio.

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