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Dancing with Machines: A New Materialist Dramaturgy for More-than-Human Encounters

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1 Introduction

Picture yourself entering a dance studio situated in an old warehouse in Melbourne. A woman sits beside what appears to be a plain wooden cube, her body gently pressed against its surface. Together, they slide across the floor with barely perceptible movement, approaching another cubic form. This second cube suddenly tilts toward them, hovers briefly, then pivots and softly accelerates upward. Your attention follows this curious encounter as a third cube enters the scene, but now human limbs emerge from within it, extending like searching tendrils. One foot reaches the second cube, tracing its edge with surprising delicacy. It responds by smoothly swiveling toward it while revealing a set of three wheels beneath its angular shell.
Suddenly, the woman we saw first stands tall, her upper body concealed within the wooden cube slightly tilting forward. Together they become an antennae-like entity, slowly rotating as though scanning the room. The unfolding configurations reveal entanglements more complex and ambiguous than simple composites like co-habitation or body augmentation; they are somewhat more-than-human[1]—bodies and things becoming entangled, extending, and transforming each other.

You are witnessing a scene from our experimental performance installation, *Dancing with the Nonhuman*, with boundaries between subjects and objects becoming increasingly porous, stretching, bending, and eventually collapsing. The strange dynamic constellations challenge

[1] "More-than-human" refers to a relational ontology recognizing the complex entanglements, frictions, and co-constitutive roles of nonhuman entities—a doing and thinking *with*, rather than to, about and for, to reimagine human-nonhuman relations (see Braidotti 2013, Barad 2007).

common conceptions of human-robot relationships, inviting audiences into a world where human-bodies and machine-things are a matter of entanglement and emergent more-than-human meanings. Rather than interactions between pre-existing, separate entities, we are noticing dynamic encounters where both bodies and things, humans and machines, emerge through their entanglement. This ontological shift could matter deeply for how we envision and create our robotic futures. Current approaches to human-robot interaction often get caught in what Karen Barad (2003) calls the "representationalist trap" of reflection—investing heavily in making machines mirror human features and behaviors to bridge what's seen as an ontological gap between humans and robots (Guzman, 2020).

These “deep asymmetries” between person and machine (Suchman, 2007) are a core challenge in designing robots ready to live and work amongst us, sharing our social spaces. Consider Pepper, an early generation, still widely deployed, social robot platform whose promotional video[2] proclaimed: "Pepper is here to make people happy, help them grow, and enhance their lives. Think of it as high tech you can high five [...] because Pepper is a friend, an advisor and a business partner—the emotional humanoid robot built to benefit mankind" (SoftBank Robotics, 2016). This vision of our robotic future relies on making machines mirror us – helpful, polite, and gendered to facilitate bonding as we "high five" them. The otherness inherent to machines is seen as something that requires masking or to be overcome through familiar features and social protocols. Yet these efforts to mask machine otherness through humanlike mirrors do more than fail to bridge these asymmetries; they perpetuate hegemonic politics that dismiss and demobilize the matterings of both less privileged humans and nonhumans alike, arresting both bodies and things in mimicry and servitude.

But what if, instead of trying to mask the profound differences between humans and machines, we could get entangled with and resonate with something more-than-human? How might we participate in meaningful relationships precisely through embracing and aesthetically exploiting these differences? This is the terrain of our Machine Movement Lab (MML)[3], a speculative art-led research practice that seeks to reimagine our relationships with robots through the material lenses of dance, creative robotics, and posthuman[4] dramaturgy. Rather than designing robots to reflect familiar human features and behaviors, MML embraces and aesthetically exploits differences by exploring how movement and its dynamic

[2] AldebaranRobots (2016). Meet Pepper the Robot | Softbank Robotics, promotional video: www.youtube.com/watch?v=kr05reBxVRs

[3] The Machine Movement Lab (MML) project was co-founded by Petra Gemeinboeck and Rob Saunders at UNSW Sydney in 2015. Since then, the project has evolved through significant international collaborations across Australia, UK, Austria, the Netherlands, and Canada, including De Quincey Co. (Sydney) with director/choreographer Tess de Quincey, and performers Linda Luke and Kerstin Packham; kondition pluriel (Montreal/Vienna) with co-director/choreographer Marie-Claude Poulin; performers/ choreographers Audrey Rochette, Felix Palmerson, Arabella Frahn-Starkie, and Siobhan McKenna; dramaturge Maaike Bleeker, and LMA researcher/choreographer Roos van Berkel. The project has been partly supported by the Australian Government through the Australian Research Council (DP160104706 and FT190100567); the Austrian Science Fund (FWF, AR545); the EU Framework Programme (FP7, 621403); and Creative Victoria.

[4] Posthuman" here draws on Karen Barad's and Rosi Braidotti's notion of the posthuman as moving beyond anthropocentric thinking and hierarchical perspectives, see Barad (2003) and Braidotti (2013).

qualities can propel meaning-making between radically asymmetric embodiments. Our goal was to open up a more-than-human playground for reimagining how robots look, learn, and affect us by harnessing the generative potential of movement and its dynamic, relational qualities to explore transcorporeal entanglement and empathy in human-robot encounters. The robots we design and employ are abstract, machinelike artifacts, forged from a practice of entangling with and becoming-with the machinic embodiment and its unique, nonhuman qualities. Becoming-with[5], in this context, refers to the process of attuning to and resonating with the otherness of the robotic artifact.

MML brings together a diverse team across creative robotics, choreography, dance, machine learning, motion capture, movement analysis, and music composition[6], working across robotics labs, dance studios, fab labs, and gallery spaces. As lead researcher, I direct the project and methodological development, drawing on concepts from feminist new materialism and radical embodied cognition[7] to both inform and be expanded through our material, experimental process. This theoretical-practical interplay is core to our approach and manifests most actively in my role as posthuman dramaturg during our choreographic experiments, where I bring concepts like intra-action (Barad 2007) and difference-in-relation (Gemeinboeck 2021) to the studio to become part of our material dialogues and embodied discoveries. Our process thus unfolds through ongoing material-discursive feedback loops, where theoretical insights emerge from and materialize through practice while simultaneously mobilizing and providing interpretive lenses for our experiments.

Crucially, these feedback loops extend beyond human participants to include a wide range of materials—from cardboard and PVC tubes to motors and software programs. Rather than passive objects to be manipulated, these materials are active co-participants in our creative process. We attend carefully to their unique affordances, the relational possibilities as well as the resistances they open up through material exploration that adopts contact improvisation techniques to our distinct practice of human-machine entanglement. This involves getting intimately entangled with a wearable costume[8] that mirrors the robot's material-relational affordances. Our dance collaborators have become adept at contact improvisation with

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[5] See also Donna Haraway's notion of 'becoming with' as conceptualized in *When Species Meet* (2008:17), positing, "[t]he partners do not precede their relating; all that is, is the fruit of becoming with".

[6] My long-term collaborator Rob Saunders, with expertise in computational creativity, leads the robotics and AI development. Key collaborators from dance and choreography include Audrey Rochette, Tess de Quincey, Felix Palmerson, Linda Luke, Arabella Frahn-Starkie, Siobhan McKenna, and Roos van Berkel, among others who have shaped the project's evolution over the past ten years.

[7] MML integrates Barad's posthuman account of performativity and agency as intra-active enactment (2003 and 2007) with an understanding of meaning-making as inherently "relational, experiential, and enactive" (Johnson 2018:244). Diverging from classical cognitive science, embodied cognition positions embodiment and interaction dynamics as central to the process of meaning-making (Lindblom, 2020; Di Paolo et al., 2010; Gallagher, 2005; and Varela et al., 1991). It is important to note that "performative" here does not imply dramatic or artistic performance, referred to as "performance-based" instead.

[8] Our cube costumes typically feature a sturdy frame constructed from aluminium extrusions and lightweight, rigid materials such as fluted plastic, thin plywood, or foam board for the cube faces. For the top plane, we use aircraft plywood to enable dancers to climb on, sit on, or move across the cube.

abstract, cube-shaped costume-artifacts, extending themselves into, inhabiting, or wrapping around them to feel into, respond to, and move-with their nonhuman forces and sensations. These more-than-human entanglements enable us to attend to and probe the aesthetic potential of difference-in-relation. They do so by eliciting productive enmeshment of material propositions, kinaesthetic experiences, movement dynamics, and relational possibilities for meaning-making.

At the beginning of MML in 2015, we deliberately started out without a predefined robot design or fixed notion of what form our mechanical co-performer should take. Instead, we began with movement itself – experimenting with how different materials and shapes transform through motion and what kinds of relationships they might engender (Gemeinboeck and Saunders 2017). Our first experiments involved dancers becoming entangled with a wide range of materials to kinaesthetically feel and extend into other-than-human forms and their relational-performative effects (Gemeinboeck 2021). This deeply embodied, discovery-oriented process was crucial for challenging our assumptions about what a social artifact could be, how we might relate to it, and establishing the investigatory, more-than-human playground.

From these early material explorations emerged key insights about the potential of movement to generate affect, meaning, and resonance across radically different bodies. Simple geometric shapes— when activated through movement dynamics—can produce surprisingly rich relational dynamics without relying on humanlike features.
This discovery led us to focus on investigating the cube's relational potential as a machine performer. The blank canvas offered by this plain, regular shape, when juxtaposed with dynamic movement qualities, opens up a wide space for potential expressive transformations and relation-making, as we will see in later sections. We developed an embodied mapping methodology that harnesses dancers' tactile-kinesthetic expertise to extend and feel-into this other-than-human, cubic embodiment and explore and capture the hybrid relational dynamics that unfold in the resulting more-than-human entanglement (detailed in section 4).

The more-than-human orientation that we seek in our methodology also guides our robot design: rather than imposing human features and movement patterns onto machines, we seek to explore new more-than-human movement dynamics—an intermeshing of human and machine's very different ways of being. The costume enables us to capture the kinetic dynamics that emerge in this hybrid entanglement, which then inform the machine learning of the robot—designed to mirror the costume's shape—by seeding its movement improvisations. This process inherently incorporates the constraints and affordances of the robot's physical form into its behavioral potential, grounding its improvisational capabilities in its specific machinelike morphology and relational dynamics (Gemeinboeck, 2021). The

resulting robotic prototypes, *Cube Performer #1* and #2[9], are trained to move based on these hybrid movement patterns while still participating in encounters through their uniquely machinic-cubic ways of moving and relating to the world.

The remainder of this chapter traces the development of this new materialist dramaturgy and its implications for expanding and diversifying our relationships with robots. Section 2, 'Beyond the Cartesian Divide: Reimagining Human-Robot Relations,' brings feminist new materialist concepts into dialogue with artistic practices that materially challenge dominant representationalist assumptions in human-robot interaction, establishing the theoretical foundation for moving beyond reflection toward difference-in-relation. Section 3, 'The Ontology of Encounter: A New Materialist Framework for Human-Robot Relations,' discusses how our practice mobilizes diffraction as both an theoretical framework and material methodology and explores how movement is understood as a diffractive, generative phenomenon. Section 4, 'Bodying-Thinging: A Practice of Becoming-With,' details our methodological journey from initial investigations and examines the core concept through which we understand how subjects and objects emerge and transform through their encounters. Section 5, 'Performance-Making as a Diffractive Tool,' examines how our expanded Relational Body Mapping (RBM) methodology mobilizes performance-making to investigate nested entanglements between multiple performers, costumes, and robotic artifacts.
Section 6, 'Dancing with the Nonhuman: Performance as Artistic Laboratory,' explores how our performance score emerges from interference patterns and shares these transformative encounters with audiences. Finally, section 7, 'Human-Robot Experience (HRX): Toward an Ethics of Co-Worlding,' examines the broader implications of this ontological shift for robotics practices and charts future directions for human-machine encounters. We argue that moving beyond reflection toward difference-in-relation, opens up new possibilities for how we imagine and create our sociotechnical futures.

2. Beyond the Cartesian Divide: Reimagining Human-Robot Relations

The common, underlying assumption that social robots require humanlike features to create meaningful connections exposes deeper ontological concerns about agency as attribute and ontological hierarchies. Human-robot relationships here are interactions between discrete, pre-existing subjects and objects, with the latter assumed more relatable the more subject-like they appear. Agency is seen as a property that robots can be imbued with through humanlike

[9] The movement requirements for the Cube Performers' mechanical design were derived from an analysis of over 10 hours of motion capture data collected from performers inhabiting and activating a cube-shaped costume (75x75x75cm). This hybrid motion data informed the necessary degrees of velocity and acceleration, as well as the ranges of movement—vertical, horizontal, and rotational—that the robot needs to perform rich movement dynamics. For more details on the early design stages, see Gemeinboeck & Saunders (2018) and Gemeinboeck (2021).

features or behavioral patterns. Yet from a feminist new materialist perspective, boundaries between subjects and objects are not pre-given but enacted through material-discursive practices (Barad, 2007; Suchman, 2007)—such as human-robot interaction itself. These Cartesian divisions manifest as boundaries that inevitably determine who and what matters, whose agencies are affirmed or inhibited (Suchman, 2011; Treusch, 2020).

Feminist new materialist thinking challenges our tendency to mirror ourselves in our technological chimera. This representationalist approach of reflection only serves to keep us and the world at a distance, whereas diffraction as a methodological tool can attune us to the effects of difference that characterize our more-than-human relationships. Diffraction "attends to the relational nature of difference" (Barad, 2007, p. 72), in contrast to reflection, which "only displaces the same elsewhere, setting up worries about copy and original" (Haraway, 1991, p. 16). According to Barad (2003:808), a diffractive approach calls "into question the givenness of the differential categories of 'human' and 'nonhuman', examining the practices through which these differential boundaries are stabilized and destabilized". A diffractive approach thus troubles subject/object and human/nonhuman dichotomies by embracing relationships where "entities diffractively crisscross, interfere, and co-establish one another" (Geerts and van der Tuin, 2021:174). These theoretical insights find material expression in artistic practices that investigate human-machine relations through performance.

Performance-making offers a unique lens for investigating human-robot relationships by revealing their fundamentally embodied, situated, and interdependent nature. Rather than understanding robots as autonomous agents, a performance perspective foregrounds how meanings and agencies are always embedded in a wider sociocultural network. Artists have long mobilized performance concepts to create 'living' sculptures or machine performances that both critically and playfully probe into intimate couplings between human and machine bodies to evoke new affects and ways of being. The artistic works discussed here materialize three key aspects of our theoretical framework: co-dependence and hybridity, material agency through movement, and difference-in-relation.

Co-dependence and hybridity underscore Marco Donnarumma's critical aesthetic investigations, with his performance practice emphasizing the co-dependence of human and machine embodiments, moving beyond the notion of a "pairing of two different things" (2017). His performance Corpus Nil (2016) revisits the hybrid embodiment of the figure of the cyborg, both unveiling and unfolding an "inherently hybrid and relational corporeality" (2017). Along a similar trajectory, Louis-Philippe Demer's earlier performance work Devolution (2006) challenges the Cartesian view of bodies by extending them with creature-like robotic limbs. Human bodies and robotic performers share equal ontological status while maintaining their distinct operational modes and material qualities.

Material agency through movement is a theme often investigated via abstract machine performers, focusing on how their uniquely mechanical embodiment evokes affective responses through movement qualities. Demers' The Tiller Girls (2010) brings together 32 simple robotic performers whose seemingly chaotic yet rhythmic hopping movements produce surprisingly rich relational dynamics despite—or perhaps because of—their machinelike nature. Rather than masking machine otherness, this work aesthetically exploits the juxtaposition between mechanical form and dynamic movement. This interplay also drives the whimsical performance of Kris Verdonck's Dancer #3 (2010), displaying the energetic clumsiness of an optimistic clown in empathically accessible yet distinctly machinic ways. Verdonck (2018) affirms that "in [his] work, Objects (dead matter) and Subject (people, living matter) are constantly intertwined".

Difference-in-relation manifests in works that explore how meaning arises from the contrast and interplay of diverse embodiments and modes of movement. Bill Vorn, Emma Howes and Jonathan Villeneuve's performance Grace State Machines (2007) explicitly explores questions of kinesthesis and perception in the dialogue between human and machine performers. The work deliberately heightens the contrasting qualities of abstract mechanical actuations and organic human expressions, while generating new forms of embodied dialogue and symbiotic relationship. Similarly, the poetic potential of Paula Gaetano Adi's works Alexitimia (2005) arises from the juxtaposition of form and resonance, demonstrating how abstract machines can generate affect through bodily encounter rather than representation.

These artistic works offer important precedents for situating our practice by demonstrating how performance can materially challenge representationalist approaches to human-robot relations. They effectively put into practice what Seibt et al. (2020) term "sociomorphing"—countering the dominant narrative of anthropomorphism in human-robot interaction by emphasizing our ability to directly and empathically perceive the social behaviors that robots exhibit, independently of their form. This reframing acknowledges robots' unique capacities for social interaction by promoting a form of empathy based on understanding these other-than-human capacities rather than projecting human-like qualities onto machines.

MML's proposition is that embodied investigations into difference-in-relation and, from there, difference-in-resonance are key to reimagining our relationships with robots. Exploring how difference can generate new possibilities for attunement and meaning-making, shifts our focus from representation to performativity—from conceiving robots as imitative social actors to recognizing them as unique material performers whose social capacities emerge through their distinct yet relational machinic enactments.

The stakes are high: how we imagine human-robot relationships shapes the very possibilities for our sociotechnical future. Continuing to pursue reflective approaches risks reproducing and reinforcing existing power structures; diffractive practices, in contrast, open up

possibilities for what Haraway terms "becoming with" (2008)—where both participants, body and machine-thing, emerge through their material encounter.
Attending to and designing-with difference (Gemeinboeck 2021) thus unlocks the potential for more nuanced and performative human-machine relations. The challenge then becomes not how to make machines more humanlike but how we can attune to their unique qualities to enable new forms of more-than-human social and aesthetic experiences.

The following sections explore how the Machine Movement Lab project mobilizes these concepts through movement-based investigations that exploit the performative aesthetics of more-than-human encounters.

3. The Ontology of Encounter: A New Materialist Framework for Human-Robot Relations

Adopting a feminist new materialist perspective materialises the ontological shift from pre-existing subjects and objects, interacting, to emergent, hybrid becomings and boundaries, intra-acting. This fundamentally transforms how we can approach human-robot encounters by positioning us within the ongoing matterings and reconfigurings of the world (Gemeinboeck 2021)—a positioning that opens up possibilities beyond the binary choices of humanlike versus machinelike, and beyond the hierarchical politics that they serve to maintain.

Becoming-with the ongoing reconfigurations of the world fundamentally hinge on understanding agency not as a property that can be designed, but as "a matter of intra-acting ... an enactment" (Barad, 2007, p. 178). Looked at through Barad's lens of agential realism, agency emerges in-between participants—human and nonhuman—as they intra-act and co-constitute each other through dynamic exchanges. This reframing radically alters how we approach human-robot relations: rather than trying to bridge an assumed gap between separate entities through mimicry, we need to attend to how subjects and objects emerge through their material encounters. This ontological disposition is deeply intertwined with matter's active participation in world-making. New materialist thinking understands matter as active, dynamic, and inventive, moving between "the animated and automated, bodies and environments" (Coleman et al., 2019). Looking at human-robot interaction through this lens highlights the participatory capacity of nonhuman matterings and how subjects and objects co-constitute each other. It prompts us to adhere to how our practices, such as doing robotics, enact cuts that produce separations and effect boundaries (see Barad 2014).

Our practice mobilizes diffraction as both theoretical framework and material methodology, allowing us to attend to and participate in the ongoing reconfiguring of what bodies and machines can be and become together. As Barad (2007) argues, diffraction attends to the specificity and materiality of entanglements, enabling us to trace how differences materially

matter in human-robot encounters. As both tool and practice, diffraction thus makes manifest the destabilization and stabilization of boundaries (van der Tuin, 2014), collapsing the distance between subjects and objects to bring them into resonance. The phenomenon of diffraction materially manifests in our practice through interference patterns that emerge through the entangling of dance performers and machine artifacts. Just as waves overlap to form composite waveforms, human and machine embodiments superpose to generate new patterns of relation. These patterns are dynamic and arise from the hybrid reconfigurings of both human and nonhuman movements, generating new possibilities for relation- and meaning-making. Collaborator and dancer, Audrey Rochette, observes that performers' relations with the cube costume continually oscillate between three modes: becoming a hybrid extension of the body through small points of connection, merging into a unified whole through shared attention, and the cube serving as a material support structure.[10] These fluid transitions between different relational states demonstrate how the performers' material negotiations challenge fixed categories of subject and object, generating varying degrees of entangledness, with each new configuration opening up yet other possibilities for becoming-with.

Movement plays a crucial role in this ontological reframing. In conventional robotics, movement often serves functional purposes—navigating space or expressing predefined states and personalities.[11] When employed for social interaction, movement becomes another tool for mimicking human behavior patterns. This instrumental view misses the potential of movement as a generative force capable of producing new relations and meanings through material dynamics. In our MML project, movement becomes a material-diffractive phenomenon itself, generating interferences and entanglings that give rise to affects and meanings beyond predetermined scripts or behaviors. It is this material-relational force that mobilises subject-object boundaries by propelling interference patterns that hybridize bodies and things or render them tentacular.

The new materialist dramaturgy extends these dynamic possibilities by aesthetically exploiting difference and amplifying the meaning-making potential of these interference patterns. How can corporeal entanglements with machine artifacts and their different material-relational qualities open up new modes of transcorporeal empathy? By embracing machinic differences rather than attempting to mask them, we seek to challenge hegemonic politics and instead propose that meaningful social encounters emerge through the specific

[10] Audrey Rochette, video annotation, video recording of an improvisational experiment, Melbourne, February 2023 (unpublished).

[11] Exploring the potential of movement for social meaning-making is still a highly underexplored area in robotic design. Some exceptions include Hoffman and Ju's 2014 seminal paper, "Designing robots with movement in mind," which highlights the untapped potential of expressive movement in robotic design, suggesting it can illuminate robots' actions and capabilities. Jochum et al (2016 and 2019), LaViers et al (2018), and Cuan (2021) propose that performing arts and choreography offer innovative strategies for designing human-robot relations. Sirkin et al. (2016) have developed an improvisational design approach that turns everyday objects into communicative social artifacts.

performative-relational dynamics that different bodies and things bring to the encounter. This ontological dramaturgical approach both shapes and continuously evolves through our embodied studio-based inquiries and performance-making practice, mobilizing and attending to agential enactments and how they render differences relational by re-enacting boundaries. During our performance-making periods, the challenge becomes how to create conditions where bodies and things still genuinely intra-act rather than simply re-perform what has worked in previous iterations of the score. The continuous transcorporeal attunement required aligns with what Cvejić (2016) calls "choreographing problems"—creating situations that provoke new forms of bodily-material engagement rather than prescribing solutions.

4. Bodying-Thinging: A Practice of Becoming-With

Our practice unfolds through embodied, improvisational encounters that materially expand on theoretical concepts such as intra-action and diffraction through careful attention to the ongoing reconfigurings of bodies and things. To explore this further, let's begin by stepping straight into our dance studio, temporarily set up in a robot lab space, to witness one of our initial experiments from 2015.

A large cardboard box lumbers toward my camera, with a pair of human feet delicately tiptoeing beneath. About two meters away, the choreographer sits on a lounge chair, bent forward, intensely attending to the box. Around us are various robot platforms, cables, and tools - reminders of the lab's usual purpose. The choreographer calls out "listening!" and we observe the box gently lifting and twisting sideways, hesitating. "Question mark!" comes the next prompt, met with a muffled "what?" from inside the box. After a brief pause, the box begins to ascend, tilted at an angle, seemingly positing layers of time along the way, as if duration itself could perform a shape. This motion swiftly transitions into a rapid twist and upward acceleration before halting abruptly.

When we later review the recording together, we notice how the box's weight actively participates in shaping the trajectory - it is not simply a dancer controlling an object but a bodily processing of what a question mark does, interfered with by the materiality of the cardboard container, and gravity, no less (Gemeinboeck 2022). The dancer, Kirsten, describes how she was "just searching, attempting to find a trajectory with the box, struggling to not lose balance." Yet in this struggle, with the weighting of the box changing along the search, the artifact clearly participated in the shaping and rhythming of this performance of a question mark. This seemingly simple experiment reveals the core of our ontological approach—subjects and objects are not pre-existing, separate entities but rather co-emerge through their material encounters.

Our first choreographic experiments began with unfixing relations through material investigation rather than focusing on predetermined tasks or fixed interactions. Early

experiments involved dancers bodily extending into a wide range of material propositions - from soft textile structures to architectural forms with fiberglass ribs. Different material affordances propelled or constrained the emergence of more-than-human movement qualities: soft shapes relied too heavily on dancers' morphology to manifest their own material agency; architecture-inspired forms with elastic ribs produced interesting geometric reconfigurations yet restricted subtle movement dynamics core to our investigation.

Through these explorations, the cube emerged as a powerful vehicle for investigating difference-in-relation and how it can transform an artifact. Its regular, omnidirectional geometry fundamentally differs from organic structures with their inherent hierarchies of front/back and top/bottom, limbs, and bilateral symmetries. This radical difference from human embodiment becomes generative precisely because it resists anthropomorphic interpretation. Static, it presents as a simple geometric form, but once activated through movement, it generates surprising affective qualities - teetering precariously, swaying gently, suddenly shifting weight and thumping onto the ground. This juxtaposition between the cube’s familiar regular, plain form and a rich repertoire of movement dynamics destabilizes its 'objectness' and opens up possibilities for meaning-making that arise through, rather than despite, its otherness.

From these early experiments emerged our Performative Body Mapping (PBM) methodology—a contact improvisation technique that employs a wearable costume as a low-fidelity prototype, standing in for a becoming-robot's shape and its unique spatial-relational affordances. The costume facilitates an intimate bodily dialogue with a robot's nonhuman possibilities, a material negotiation between dancer and costume generating new forms of contact improvisation specific to this human-cube hybrid. Entangling and moving-with a cube artifact highlights that qualitative dynamics and material forces are inherently intertwined—each spatial-temporal-energetic quality (Sheets-Johnstone, 2012) is also shaped by and kinaesthetically felt through the cube and its material forces. 'Speaking-with-cube' thus constitutes a unique form of contact improvisation, where the "phenomenological blurring" (Mullis, 2021: 635) between bodies involves a nonhuman participant. The interplay of ongoing material contact—bodily listening and responding, extending and being extended—and the movement dynamics that both emerge from and shape the possibilities for contact is where agency is enacted through this entanglement. Audrey describes, "The mapping is truly fluid, with constant back-and-forth between what I project onto the cube and its materiality, which imprints itself on me and transforms me. It's a dialogue" (Rochette and Gemeinboeck 2022). The Cube Performer, in turn, learns to 'speak-with-body' by embodying the relational, diffractive movement patterns that arise from these performer-cube entanglements, co-manifesting this more-than-human exchange and alliance.

This transcorporeal dialogue manifests in what I have termed bodying-thinging - drawing on Manning and Massumi's (2014, p.39) notion of bodying as movement that "bodies forth" rather than "something the body does," and Heidegger's (1971) concept of thinging which

untethers the thing from an object's utility.[12] Bodying-thinging puts into practice Barad's (super)position of "together-apart" (2014, p. 168)—each entanglement generating its own unique pattern of interference and relation. Bodying-thinging traces the continuous differentiating-entangling that occurs as dancers and artifacts intra-act. It is a lens for carefully attending to the interference patterns generated in this entanglement and exploring how meaning emerges not from fixed categories but through the dynamic interfering of bodies and things as they "undo and redo each other" (Despret, 2013, p. 61).[13] The concept thus serves as a methodological bridge between new materialist theory and embodied practice, illuminating how subjects and objects emerge through their material encounters rather than pre-existing their relating.

It is only when dancers reorient toward the sensations they receive from the costume and reconfigure themselves to become-with the cube that they begin to bodily feel-think-with and move-with it. This is where interference patterns begin to emerge. As Audrey reflects:

> "I remember that the first times I inserted myself into the cubic costume and began to manipulate it, I grew impatient because I couldn't manage to control it. … I must place my hands, or another surface of my body, against the plywood walls … to anchor my points of contact and execute an outward push, an abduction. It is through this action, performed in opposition between two points of support and the anchoring of my legs to the ground, that I gain enough control over the costume to produce different movement qualities. However, … this abduction movement is also a negotiation: the significant constraint exerted on me by the materiality of the costume forces me to feel it, to receive it, in its full constitution. Despite a certain flexibility in the walls, the material exerts a centripetal resistance to my push. … Thus, within these points of contact with the costume, an oscillating alternation unfolds between the centripetal action of constraint and the centrifugal dynamic of my bodily expression; sensing and acting overlap in a perpetual loop. This means that the movement produced is not solely mine; it is the result of a dialogue with the object. … Listening to the behavior of the material transformed a simple strategy of manipulation into a conscious dialogue, and this newfound sensitivity eventually opened the door to a richer kinaesthetic relationship. It is through this sensitivity that I became aware of the sensory abundance in my exchanges with the costume, and of the possibility of allowing its materiality to imprint itself on me, which sometimes

[12] This also aligns with Latour's concept of 'technical mediation': in *Pandora's Hope* (1999) and *Reassembling the Social* (2005), Latour argues that technical mediation transforms both human and non-human actors through their interaction, reshaping their capacities, agencies, and the very nature of their relationship.

[13] Writing about the ways we seek to understand animal behavior, Vinciane Despret describes transformative bodily reading and communication as a process of "'undo[ing] and redo[ing]' each other" (2013:61). Despret's (2013) notion of embodied empathy frames this ongoing attunement as reciprocal yet asymmetrical, and always inherently partial.

had the effect of blurring our physical realities in my perception" (Rochette and Gemeinboeck 2022).

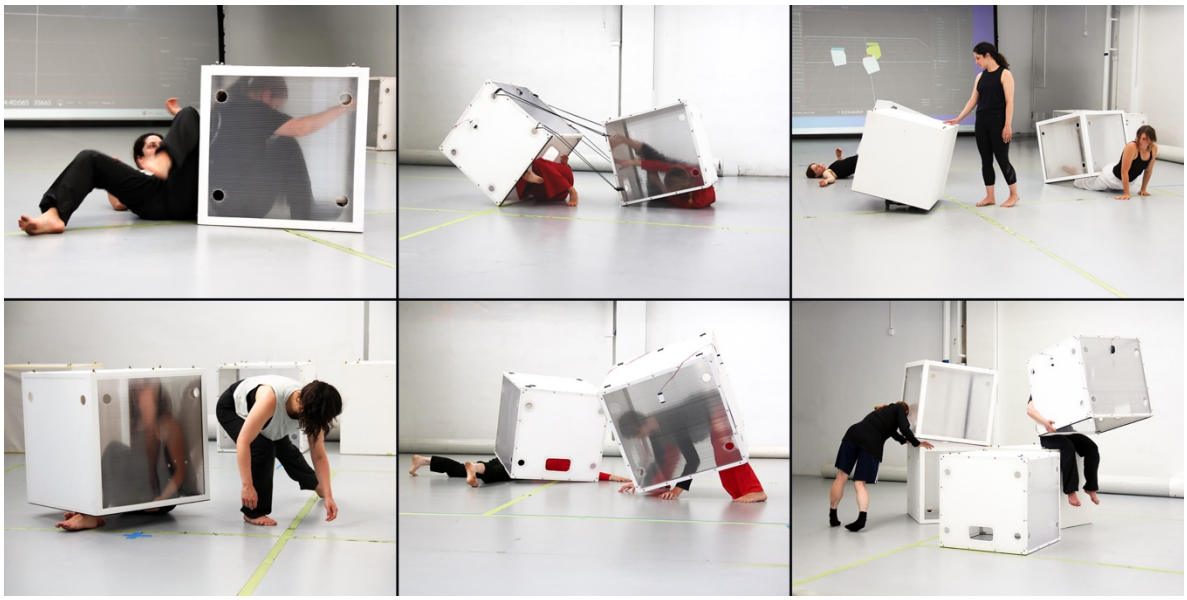
This ongoing extending-into and extending-with demonstrates the mutual transformation at work in bodying-thinging - neither dancer nor cube remains unchanged, but rather they co-constitute each other through their material exchange.

Feminist concepts like Haraway's "becoming-with" (2008) and Barad's intra-action (2007) don't just theoretically frame our practice but actively shape our experimental process by offering provocations and enabling constraints. Sometimes we work with mental imagery of nonhuman dynamics to bypass anthropomorphic interpretations and guide the reconfiguring of bodies to find new movement patterns.[14] When we ask dance artists to explore material qualities like "made of gold" or "underwater," these prompts help to mobilize material empathy as movement dynamics and explore how the entangled cube transforms in response. We also found that these material-performative analogies allow for a more open-ended, imaginative investigation of surprising movement dynamics. Dance collaborator Felix Palmerson noted that "[t]hese material images help me find ways of moving that don't belong to either me or the cube, but emerge from our encounter".[17] An earlier studio session with Tess de Quincey and Linda Luke explored the sensation of breath. The performer-cube entanglement balanced precariously on one corner while raising the opposite corner using varying qualities of velocity, rhythm, projection, and weight. The entangled cube rocked forward and upward with increasing haste, culminating in the stuttering, jumpy rhythm-shape of a hiccup. When our robot prototype learned these captured motion patterns, the Cube Performer did not mimic the act of breathing but instead embodied a distinct rhythmic quality that rendered the cube simultaneously more strange and more familiar.

The translation of embodied knowledge through PBM occurs across multiple registers and interference patterns. These patterns manifest not just in spatial coordinates but in the dynamic qualities brought forth by material negotiations—the hesitation in a tilt, the sudden acceleration of a twist, the delicate hovering of a sustained angle. Our studies with audiences and participants have shown that these hybrid kinetic dynamics performed by the Cube Performer can evoke kinaesthetic empathy while maintaining machine otherness (Gemeinboeck & Saunders, 2019). As one participant noted: "I like its non-humanness... there is a companionability to it." Another described approaching it "as a subject but then it flips around and does something else." This oscillation between familiarity and strangeness is precisely what we aim to cultivate through our diffractive approach.

[14] This mental imagery work draws on Tess de Quincey's BodyWeather practice, which uses imagery to move beyond conventional biomechanics and find ways of moving that transcend typical human movement patterns. For more details, visit: www.dequinceyco.net/bodyweather/about. We collaborated with Tess from 2015 to 2019 and her choreographic expertise in BodyWeather played a pivotal role in shaping our exploration of the hybrid movement dynamics inherent to human-machine entanglements.

The dancers' bodily negotiations with the cube costumes reveal how subjects and objects are continuously made and unmade through their material encounters. To experiment with more complex, nested entanglements, we developed our expanded Relational Body Mapping (RBM) approach. The following section examines how we adopt contact improvisation techniques and performance-making strategies as diffractive prototyping tools to investigate these tentacular configurations between performers, costumes, and robot artifacts and create experiences that invite audiences into reimagining human-machine encounters.



Machine Movement Lab Project by Petra Gemeinboeck and Rob Saunders. Snapshots from the motion capture studio, Embodied Movement Design (EMD) Studio, Swinburne University, Melbourne, 2022-2023. With dance performers A. Rochette, F. Palmerson, A. Frahn-Starkie, S. Mckenna, and S. Hutchison. Photos: P. Gemeinboeck

5. Performance-Making as a Diffractive Tool

One day at our Melbourne studio in 2023, we witnessed how attunement between multiple bodies and things evolves over time during a studio improvisation involving three dance performers, five cube costumes, and the Cube Performer (robot).[15] Audrey observed that initially there was "a certain confusion" with performers seeming disconnected, operating in different realms, "too much movement, everybody... 'talking' at the same time." But gradually, "[t]he attunement is in progress. We are a bit more in the same realm, to work together. We are searching, we begin to deepen some connecting points (conceptually and physically) with the cubes and the robot."[16] Such attunement across multiple bodies and things emerges not

[15] Interestingly, this increased number of cube artifacts foregrounds the emergence of a cubic world-making as the entanglements unfold. To navigate this dynamic cubic terrain, we experimented with contact improvisation techniques to probe into the emerging network, both spatially and temporally, and to explore emergent phenomena such as chain reactions, ripples, and echoing effects.
[16] Audrey Rochette, video annotation, studio recording, Melbourne, February 2023 (unpublished).

through predetermined choreography but through careful attention to the undulating movements and connections of a dynamic network.

Experimenting with multiple configurations of performer-cube entanglings revealed two interrelated interference patterns: the embodied attunement of bodying-thinging and the unfolding dynamic textures that emerge in the spaces between bodies and things. Both manifest as hybrid, entangled, in-between spaces emerging from our more-than-human intra-actions; they are the diffraction patterns that collapse the distance between subjects and objects and bring them into resonance. Back in the studio, we observe these patterns unfold in various configurations: a performer-costume extends toward the Cube Performer while another dancer responds to this hybrid entity or multiple cubes weaving an affective, tectonic landscape. These networked patterns of becoming-with produce what Audrey describes as different realms interconnecting, and the performers moving fluidly between realms.[16]

Our performance-making process for Dancing with the Nonhuman provided our dance collaborators with the dynamic context for increasingly refining their sensitivities to these fluid interconnections while entangled with their cube costumes. As Felix reflects, these connections can be "emergent, attentive, conversational, opportunistic, environmental."[17] The performers develop complex webs of material-spatial relationships as they attune to both each other's movements and those of the artifacts, including the robot. As part of our studio improvisations, we discovered how Relational Body Mapping (RBM) could investigate the way corporeal entanglements with machine artifacts and their different material-spatial qualities open up modes of transcorporeal empathy. As Audrey notes later in her analysis of the same improvisation session: "I see mostly the effects of the interactions... Now we are attuned and meaning-making is possible."[16] Performance-making here serves as a diffractive research tool, probing how subject-object boundaries can be reimagined and reenacted as part of the dynamic reconfigurings unfolding in the encounter. This involves carefully attending to a wide range of possible enmeshments between human performers and nonhuman artifacts—how they matter, couple, interfere, "undo and redo each other" (Despret, 2013).

In the process of developing our more-than-human performance-making practice, we have witnessed three significant interference patterns that characterize how subjects and objects emerge and transform through bodily-material reconfigurations. These patterns not only map the effects of difference-in-relation but have also shaped our performance score for Dancing with the Nonhuman, evolving into distinct dramaturgical themes that render subject-object boundaries increasingly elastic. As we will see in the following section, each pattern opens up unique possibilities for transcorporeal meaning-making as human and nonhuman performers intra-act and exposes audiences to progressively more complex entanglements between human and nonhuman performers.

[17] Felix Palmerson, studio notes, Vienna, November 2023 (unpublished).

The pattern of becoming-with first emerged through our PBM practice as dancers corporeally explored their entangledness with the cube by extending or folding into it to attune to its material characteristics through a transcorporeal exchange of forces. The cube, in this exchange, responds by producing various material sensations - shifting spatial boundaries, its weight and stability (and how they dynamically change when 'on edge'), how it bends, where it resists. This becoming-with entails mutual shaping; dancers reconfigure their bodies while being shaped by the cube's unique nonhuman affordances and learn to feel-think-move with these cubic qualities. As Audrey describes: "... while my body organizes itself, my attention shifts elsewhere, creating connections with something beyond. Then, I feel as though the box and I are no longer two separate entities" (Rochette and Gemeinboeck 2022).

Building on this initial entanglement, a second pattern emerges as performers probe and dwell along the threshold between subject and object, gradually becoming-hybrid. During rehearsals, we witnessed how this boundary becomes a gateway for transformation - a zone to linger in, extend into, and mingle with. Felix reflects: "… such a delicate place to be because you are genuinely trying to find the point at which your movement and attention sees you blurring the subject/object boundary".[17] This genuine struggle precisely indicates the ontological work at stake - not simply performing with objects but allowing new configurations of subject and object to emerge through this material dialogue. These moments produce some of our most symbiotic cube-performer interference patterns, where body-thing can no longer be separated, nor is one entirely folded into the other.

This most complex pattern reveals how subject-object boundaries become fundamentally porous and multiple, as multiple performer-costume configurations intra-act in becoming-tentacular. During the aforementioned improvisation session with three dancers and six cubes, Audrey observes this pattern unfold: "Three cubes appear together in the same realm, the humans disappear... Then, there is eventually the apparition of limbs, body parts—a fragmented body. It is interesting because it emphasizes the difference between humans and cubes."[16] This heightened complexity arises not only from the number of human and nonhuman participants but also from their emerging effects and affects flowing across the open seams of each pattern. We witness a continual process of attaching, un-attaching, aligning, re-attaching, un-aligning, involving edges, limbs, corners, and glances that are meshed, un-meshed, interlaced, untwined, and knotted again.

The becoming-tentacular pattern closely aligns with what Haraway (2016) has termed "tentacular thinking," breaking down binary thinking through transcorporeal networks and emergent compositions. She speaks of "tentacular ones [and how they] make attachments and detachments; they make cuts and knots; they make a difference" (2016, p.31). We continually witness the emergence of such tentacular configurations - new compound organisms and networks involving different kinds of entanglements and their interference effects. Audrey notices how "Felix and Siobhan create links between the cubes and the robot with their body. A network appears."[16]

These interference patterns continually expand our ontological dramaturgy, operating at multiple scales—from intimate performer-cube encounters to complex networks of human-machine relations; a multi-layered approach that has also fundamentally shaped the dramaturgical development of Dancing with the Nonhuman. The following details how we mobilized these patterns through structured improvisational scores that progressively render subject-object boundaries more porous while maintaining the productive tension between human and machine differences.

6. Dancing with the Nonhuman: Performance as Artistic Laboratory

Dancing with the Nonhuman emerged as a semi-structured, improvisational performance installation that transforms our studio-based investigations into a 25-minute live performance laboratory for audiences to witness and participate in emerging more-than-human constellations.

Machine Movement Lab: Dancing with the Nonhuman[VIE-2-2-1] by Petra Gemeinboeck and Rob Saunders; dieAngewandte, Vienna, AT; 2023. With dance performers Felix Palmerson and Audrey Rochette; composer: Robert Downie. Photos: N. Murrell (Collage: P. Gemeinboeck)

6.1 Translating Studio Practice to Performance

Translating our diffractive RBM experiments into a performance context required careful attention to how different scales of bodying-thinging can be made accessible for audiences while preserving their transformative potential. Rather than presenting a linear narrative, the performance score unfolds through choreographic motifs - scenarios that arose from our diffractive investigations of interference patterns. These motifs frame the improvisational

playground, evoking certain possibilities for encounter while restricting others. The scenarios unfold along stages of different degrees of entanglement, becoming increasingly complex and messy as the performance progresses.

To facilitate closer proximity to the ontological reconfigurings at play and challenge traditional performer-audience boundaries, *Dancing with the Nonhuman* is designed for gallery spaces rather than conventional performance stages. A simple square taped on the floor marks the performance area, echoing the cubic forms while providing a spatial reference for both performers and audiences. During transitional stages, audiences are invited to step across this boundary to corporeally participate in the ongoing reconfigurations of bodies and things (see 6.4).

6.2 The Performance Score

Dancing with the Nonhuman [VIE-2-2-1][18] comprises three main choreographic motifs — *Threshold, Con-current, Co-play*—and two transitional motifs—*Box-world* and *Tentacle*—, each emerging from and mobilizing different interference patterns explored in our studio practice. The pattern of becoming-with underpins all motifs, with each exploring its possibilities at different scales and intensities. *Threshold, Box-world, and Con-current* have evolved from our investigations into becoming-hybrid—probing, stretching and crossing the subject-object boundary. *Box-world* and *Tentacle* serve as transitional motifs that propel these boundary reconfigurations toward increasingly complex entanglements.

Co-play extends *Tentacle's* enactment of becoming-tentacular through unfurling limbs in metaphorical and playful ways, generating increasingly unpredictable tangles. This final scene opens up a playground where the familiar and strange intermingle—where childhood play meets more-than-human world-making, expanding our imagination from a place we know while propelling us toward new possibilities for human-nonhuman relations.[19]

Threshold

The opening motif manifests the initial negotiations of boundary-dwelling, -making and -unmaking. Some of our dance performers are drawn to explore the cube's geometric qualities, compelled to touch the costume's various textures, press against, or co-align stretching alongside its planes and edges. Others seek a more precarious, co-dependent relationship, attaching themselves to a face or edge, leaning in until the performer-costume assemblage

[18] *Dancing with the Nonhuman [VIE-2-2-1]* by Petra Gemeinboeck and Rob Saunders was performed at the dieAngewandte Auditorium, University of Applied Arts Vienna, Austria, on 29 & 30 November 2023, featuring dance performers Felix Palmerson and Audrey Rochette. An earlier iteration, *Dancing with the Nonhuman [SYD-2-2-1]*, premiered at the Tin Sheds Gallery, University of Sydney, as part of the SHErobots exhibition in November 2022, featuring dance performers Arabella Frahn-Starkie and Felix Palmerson, with soundscape by Robert Downie. For additional details, video excerpts, and photos, please visit the project website: www.machinemovementlab.net.

[19] For additional details and documentation materials, visit our project website: www.machinemovementlab.net

pivots, now resembling a teetering, asymmetrical three-legged entity before wobbling and crashing to the ground. This delicate balance heightens the difference between pliant, malleable bodies and rigid, sharp-edged things. Meanwhile, the Cube Performer begins with moving along straight lines and increasingly complicates its trajectories, twitching out of the grid by accelerating and tipping along one of its edges. This interplay between the dancers' nuanced probing and the Cube Performer's increasingly playful deviations from the square troubles binary notions of the human and machinic.

Box-world (transitional motif)
Evolving toward *Con-current, Threshold* gradually transforms into a dynamic landscape of cubic forms that opens up new possibilities for exploring spaces between shapes. Like exploring cave openings along sandstone cliffs, performers navigate crevices and openings between rocking cubes, slithering and bending along edges or tumbling corners. Firmly grounded in horizontality, with the cubes themselves shaping and propelling the dynamic terrain, the teetering landscape is partly shaped by interference patterns generated between the Cube Performer and dancer-cube entanglements. As dance performers find themselves in contact with multiple cubes simultaneously, the notion of becoming-with-cube expands to becoming-with-cube-world.

Con-current
Here, we witness the dance performers fully inhabiting their cube costumes, and the encounter between Cube Performer and performers-in-cubes becomes almost seamless. Interference patterns express themselves along criss-crossing geometric lines, with the interplay of geometries and movement dynamics producing uniquely horizontal patterns of flowing cubic tectonics—swaying, balancing on edges, pivoting on corners, and undulating along invisible trajectories. The cubes converse through rhythmic counterpoints, with their dynamic swelling and whirling evoking small boats dancing on wave crests. This conversation between Cube Performer and performers-in-cubes marks our project's cyclical, more-than-human interplay: the Cube Performer's movement dynamics originate from motion-captured improvisations of performer-cube entanglements, now shaping the robotic expressions, which in turn inspire the performers-in-cubes to propel their rhythmic chatter during the live performance. In the [VIE-2-2-1] performance iteration, the cubes' chatter oscillated between spread-out and contracted configurations, with cubes jostling and huddling as if sharing secrets. The twirling cube trio[20] often provokes smiles as audiences easily lose track of which cube is the robot.

Tentacle (transitional motif)
As Con-current evolves toward Co-play, one cube gently lifts to reveal limbs slowly unfurling and seemingly growing toward—yearning to reach—the Cube Performer. The

[20] Albeit horizontal in its movement expressions, 'con-current' demands hard work from the dancers, while the robot was designed and built for such dynamic whirling.

movement quality emerges from what performer Felix describes as "searching without eyes"[17]—feet and hands extend like feelers, softly probing their surroundings. Though clearly human appendages, their spread and jumbled arrangement, in tandem with the dominant cubic form, renders them strange, other-than-human. These tentacular extensions create moments of connection with the Cube Performer, cradling its edges or stretching toward it as it retreats, manifesting Haraway's (2016) hybrid compositions and how they emerge through an ongoing, fluid interplay of connection-making and -unmaking.

Co-play

In this final theme, the encounter becomes literally a playground, and it can get a bit messy; bodies and things tumble, and so do their boundaries. It is the most playful motif, sometimes evoking the image of children playing in a sandbox with boxes. Co-play also opens up the dimension of the vertical, allowing for boxes to be stacked and dancers to climb on top of them. One improvisational strategy the dancers developed involves each performer inventing a game or set of secret rules, then trying to guess and interfere with the other's game.[21] According to Felix, this produces a sense of "play, urgency, dynamic shifts, spatial changes and interesting relationships between performers and robot."[22] The imaginative constellations emerging in Co-play offer another, more whimsical side to the potential of a "box robot" and also play a significant role in our studio experiments. They serve to loosen patterns that may have become too rigid through repeated investigation, renewing our process when it gets stuck in particular or already familiar modes of relation-making and reminding us not to take ourselves too seriously.

6.3 Choreographing the Cube Performer

The Cube Performer's choreography unfolds through an iterative, interactive process deeply integrated with our performance scoring. This creates a feedback loop where robot and human performers engage in an ongoing conversational exchange that shapes the spatial score, the robot's movement vocabulary, and the performers' improvisational responses.[23] The robot choreography offers a series of spatially and temporally unfolding enabling constraints that scaffold the dancers' improvisations without determining them. Rather than "leading" or directing the dancers' movements, the Cube Performer's dynamic trajectories serve as mobile

[21] The secret game has to integrate all possible participants, including the robotic box, although they can have differing degrees of involvement in the unfolding gameplay.

[22] Felix Palmerson, studio notes, Vienna, 2023 (unpublished). For instance, Felix might attempt to maneuver Audrey as close as possible to the Cube Performer, while ensuring that Audrey remains unaware of this objective. Meanwhile, Audrey's game could involve actively disrupting Felix's strategy.

[23] Once the performance stage is reached, the Cube Performer performs a scripted choreography. Although the goal of our machine learning is for the robot to expand its movement repertoire and learn to improvise based on patterns extracted from the motion capture data, the unpredictable and sometimes high-speed nature of the performance environment makes it challenging for the robot to improvise successfully and safely.

anchor points that open up or close spaces and mark the score's undulating energy patterns—much like a buoy bobbing up and down in the sea as waves pass by.[24]

From the audience's perspective, we aim for the Cube Performer to accomplish a double movement: manifesting as a distinctly machinelike participant while also embodying the affective, entangled thing-performer that is always already part of the wider "ongoing reconfiguring of the world" (Barad, 2007, p. 170). The being different comes naturally to a 75cm cubic artifact swaying across the floor on its rubber-covered wheels. The more challenging performance—that of an affective, distributed dynamic entanglement, the ongoing becoming-with the world—emerges through the generative potential of movement: both the Cube Performer and performer-cube assemblage share the same movement language, arising from our PBM process. The score's purpose is to highlight these differences in tandem with the intricate enmeshment, oscillating between choreographic scenes that foreground the ebb and flow of entanglements between bodies and things, and the dynamic interplay of bodying-thinging.

6.4 Audience Participation and Porous Boundaries

The performance structure deliberately includes transitional intro and outro stages, during which the performance site gets gradually established and deconstructed. During the intro phase, dance performers begin by setting up the space—aligning cubes, checking materials, and speaking casually to each other. Audrey describes that she would engage with the materiality of the box, feeling its weight, replacing it, “looking how my cube 'behaves' if I do this ... allow[ing] and acknowledge[ing] the thing as a thing before transforming it into something else."[25] This ensures that the entry into bodying-thinging is gradual and begins with everyday interactions, making tangible how subject-object boundaries can become mobile.

Throughout these transitions, audiences are welcome to move within the marked performance area, mingling with both human, cubes, and Cube Performer as they slowly shift across boundaries and settle inside the grid space. At the performance's conclusion, audiences are encouraged to physically explore their own potential for bodying-thinging with the cubic artifacts guided by the dance performers. These encounters can range from simply sitting and leaning against one of the cubic artifacts to touching the Cube Performer and gently rocking along with it or even climbing into one of the costumes to experience the playground from within the artifact's material configuration. These opportunities for direct engagement allow audiences to bodily explore the performers' perspectives and become entangled themselves. This transcorporeal perspective-taking confronts participants with the indeterminacy inherent

[24] The soundscape offers the dancers additional cues for transitions between choreographic themes. We have since developed an interactive soundscape that responds to and is generated by the unfolding dynamics of the Cube Performer and cube costumes.
[25] Audrey Rochette, studio notes, Vienna, November 2023 (unpublished).

in more-than-human encounters. As one audience member commented: “It felt like a Turing Test but in reverse; the boundary between human/object is quite fascinating.”[26]

Our approach to audience engagement builds on the understanding that meaning emerges through situated, material encounters and our bodies are always already porous, more than human (Homewood et al., 2021, Gemeinboeck 2022). We have engaged audiences and stakeholders in forms of transcorporeal empathy and perspective-taking since MML's early project stages.[27] As one participant reflected on their encounter with the Cube Performer: "I was surprised how intimate it was. I responded to it like another species and increasingly so" (Gemeinboeck and Saunders 2022). These embodied experiences have shaped *Dancing with the Nonhuman* as an artistic laboratory for investigating and sharing more diverse and horizontal approaches to human-robot relationships. Yet, the transformative potential of this practice extends beyond performance contexts, challenging fundamental assumptions in robotics and artificial intelligence—implications I explore in the following, final section.

7. Human-Robot Experience (HRX): Toward an Ethics of Co-Worlding

Our practice is driven by the need for an ethics of co-worlding[28] in how we imagine and materialize our relationships with robots—one that emerges through more-than-human intra-actions rather than representational mirrors. This final section briefly examines how moving beyond the fixed subject-object boundaries of traditional Human-Robot Interaction (HRI) introduces a fundamental ontological shift in how we conceptualize human-machine relations, toward what I have termed Human-Robot Experience (HRX). We explore how this diffractive framework—grounded in difference-in-relation and transcorporeal empathy—could transform social robotics practices more broadly.

HRX proposes a fundamental shift from human-robot interaction to human-robot experience (Gemeinboeck and Saunders 2023)—moving beyond interactions between separate agents to understand how subjects and objects emerge through their material encounters. This reframing opens up three key possibilities: First, it enables new forms of embodied prototyping where designers work from within the encounter rather than controlling it from the outside. Second, it cultivates transcorporeal empathy through embodied encounter and bodily attunement where human bodies extend into and resonate with machine otherness, while machines participate through their unique material-relational qualities. Third, it enacts co-worlding through resonance patterns that reveal the hybrid and tentacular capacities of

[26] Based on an audience survey conducted at the Tin Sheds Gallery, Sydney, November 2022, as part of *Dancing with the Nonhuman [SYD-2-2-1]*. In this survey, we also asked audiences about their sense of connection with the dancers and the cubic artifacts. 64% reported feeling a connection with the dancers, while 36% either did not feel or did not notice a connection. Interestingly, responses regarding the cubic artifacts were similar: 59% felt a connection with them, whereas 41% did not feel or did not notice feeling a connection.

[27] See Gemeinboeck & Saunders (2018, 2019) for a detailed discussion of our participatory studies.

[28] Karen Barad (2007:392) states, “[w]hat is needed is a posthumanist ethics, an ethics of worlding.”

both bodies and things, following Alaimo's (2010) understanding of transcorporeal co-worlding, where bodies are always already more-than-human. Together, they transform how we imagine and participate in human-robot relationships, emphasizing material, more-than-human entanglement over representational mirroring.

This diffractive framework troubles traditional hierarchies between humans and machines, designers and users, suggesting broader implications for how robotics and artificial intelligence might develop more horizontal and inclusive approaches to human-machine relationships. Through performance-making, our practice materially intervenes in conventional HRI approaches, generating embodied knowledge through more-than-human modes of exploration. HRX thus reframes human-robot encounters as co-created, evolving relationships where social agency emerges through performative, relational dynamics. This emphasis on performative embodiment and difference-in-relation expands not only our imagination of what robots could be but also suggests new directions for embodied AI (Pfeifer et al. 2014). Rather than programming predetermined social behaviors, we leverage the morphological characteristics of artifacts to facilitate sense-making and relational behaviors, drawing on dancers' kinesthetic awareness to attune to machinelike forms.

Dancing with the Nonhuman materializes the meaningful, more-than-human relationships that can emerge when we bodily resonate—bodying-thinging— with other-than-human artifacts. We believe this approach, foregrounding transcorporeal attunement and embodied empathy, can be extended to a wide range of machinelike robot designs, opening up pathways for diversifying human-robot relationships beyond the current focus on humanoid or animal-like forms. To share and explore these possibilities with wider groups of stakeholders, including designers and engineers, we have developed the HRX Theatre—a movement-focused, participatory methodology that engages participants in speculative, embodied world-making with machinelike robot designs[29]. This experience-centred methodology demonstrates how the generative potential of more-than-human alliances and diverse and entangled perspectives extend beyond artistic practices to inspire more nuanced and differentiated experiences with robots across various social contexts.

Dancing with the Nonhuman and the HRX Theatre seek to lay open the political potential of diffractive performance-making practices, that is, their capacity to open up ontological boundaries between subjects and objects to bodily-material reconfigurations, giving rise to an ethics of co-worlding. Such hybrid, indeterminate entanglements, in Thiele's (2016) words, "move the ethical discourse from one focused on the right conduct (assumed as given), towards one that exposes itself to the real precariousness and ambiguity of each and every of our practices." Through diffracting the making of human-machine encounters, this new

[29] The HRX Theatre builds directly on the performance-making approach developed in *Dancing with the Nonhuman*, employing our Relational Body Mapping methodology with robot costumes to facilitate embodied, transcorporeal perspective-taking and extend our transcorporeal attunement practices to non-dance expert audiences (see Gemeinboeck et al., 2025).

materialist dramaturgy of human-machine entanglements and bodying-thinging resonances manifests this—at times precarious—indeterminacy of being of this world while inviting us to continue to dance with it.

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