

ROBOT AS SELF, BLURRED BOUNDARIES, AND THE AUXTHETIC MIND-BODY: A SPECULATIVE DESIGN THROUGH POETRY

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ABSTRACT

We present the concept of the *auxthetic mind-body* (AM): a system which extends the human mind and body to include robot bodies, artificial “thoughts,” and artificial feelings as part of the perception of “self.” While human-robot interaction research has long grappled with embodiment, the AM represents an as-yet unexplored space in this realm and raises a host of questions around its uses, consequences, and preservation of human agency. We explore the concept through speculative sociotechnical design, foregrounding how the technology might make us feel (rather than what it might do) as a guiding foundation for further development. Through poetry and marginalia, we invite readers to reflect on what it might mean to think, feel, and be with an AM. In doing so, we sketch both technical possibility and future worth longing for—one where the dissolution of the human-machine boundary can be meaningful, grounded, and less frightening than it may seem.

AUTHORS KEYWORDS

robot identity; embodiment; speculative sociotechnical design

CSS CONCEPTS

- Human-centered computing~Human computer interaction (HCI)

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INTRO: THE AUXTHETIC MIND-BODY

From single-minded swarms to multiple digital agents sharing the same robotic body, many forms of robot embodiment already exist in practice—and human-robot interaction (HRI) scholars have ideated many more still through a small litany of user studies, technical papers, and position pieces [11]. We posit, however, that one variety of embodiment in this space stands out as almost wholly unexplored. Using Miranda’s model of artificial identity [16], we can reckon quite directly with the fluid nature in which we may ascribe boundaries separating aspects of human and robot identity. We can ask: What happens when we intentionally move the boundary between “self” and “other” so

that a robot, artificial intelligence, or other agent becomes a part of the human “self?”

It is not new to think of technology as an extension of both the self and the mind. The idea that we are all everyday cyborgs is at least as old as Donna Haraway’s seminal 1987 essay [10] arguing that the boundary between human and machine is blurred more often than not. A related idea is the embodied mind thesis [18] that objects and technologies ordinarily thought of as part of our environment can, in fact, be thought of as composing essential parts of our cognitive processes. When it comes to embodiment, scholars in fields such as cybernetic biology have developed similar thought—Clawson and Levin emphasize the largely unexplored option-space of novel agents combining various aspects of evolved life forms (such as humans), designed machines (such as robots), and artificial intelligences [6]. Even within human-robot interaction, one 2009 study attempted an explicit self-extension framing with various robot forms and found that it tended to work best with non-anthropomorphic robots [8]. We further see a closely related idea in Laaksoharju et al.’s consideration of the possibility of large language model-based chatbots as self-extension in the framework of Don Ihde’s human-technology-world “embodiment relationship” [13].



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Our main proposal, however, is to take all of this yet one step further by intentionally eliciting something as intimate and closely linked with selfhood as one's own internal *thoughts and feelings* to originate not in the organic mind-body but in a synthetic “add-on” to it. That is, in the same way that a prosthetic limb might be considered a part of one's body and self-concept, so too might an *auxthetic* robot or artificial intelligence be considered a part of one's *mind-body* and self-concept. While *prosthesis* has come to refer to an artificial *replacement*, here we define *auxthesis* to more precisely mean an artificial *augmentation*. For example, an extra robotic “Third Thumb” augmenting an able-bodied human hand [12] might be considered an “auxthetic thumb.”

We thus introduce the concept of the **auxthetic mind-body (AM)**: a system which extends an individual human mind-body with additional robotic bodies or artificial intelligences which generate artificial thoughts and feelings that may be conceived of as being constituent to the interactant's self-concept.

An AM is distinct from the concept of an exocortex (an extension to the brain's high-level thinking processes, typically conceived of as a direct brain-computer interface [3]) in that an exocortex might exist as just one possible component of a more general AM system. The AM concept is in line with a rejection of the Cartesian dualism¹ separating the brain from the body and recognizes that our embodied

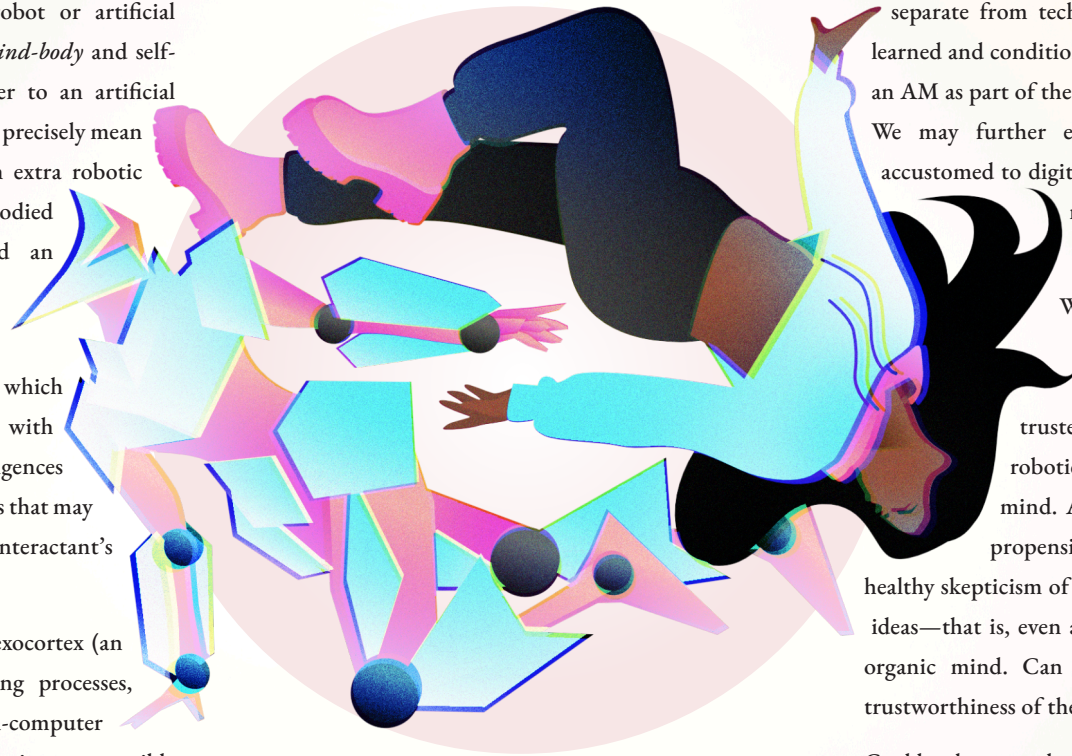
experience is an inalienable part of our cognition and conscious experience [9]. Thus, it goes beyond just the cortex to encompass bodily feelings, sensations, and agents external to an individual human as being “part” of the AM. Hence also why we refer to the “mind-body” as a single, inseparable concept abbreviated by a single letter.

an entire research program of questions arises from its existence and use. We may ask: How does it compare to other forms of embodiment? To what extent can an auxthetic mind-body be fully accepted by people as part of their selves? Does this vary across cultures, age groups, and technological literacy? We hypothesize that the “default” Western conception of the self as separate from technology is not something innate, but is learned and conditioned—and, thus, genuine consideration of an AM as part of the self, too, can be learned and conditioned. We may further expect that younger generations more accustomed to digital technologies and AI may witness more ready acceptance of auxthetic mind-bodies.

We may ask: How does trust factor in? In line with deconstructed trustee theory [19], we might expect that separate trustees may be found in the AM, any physical robotic links, and even trust in one's own organic mind. Any sufficiently self-aware subject with a propensity for personal growth no doubt carries a healthy skepticism of their own thought patterns, feelings, and ideas—that is, even a small self-distrust can be found for the organic mind. Can an AM be created to truly rival the trustworthiness of the organic mind-body?

Could such a system be of benefit in human-AI cooperative scenarios requiring fast reaction times and high amounts of trust? If AMs are linked together allowing teams of interactants to quickly share the same thoughts and information, does this bear desirable effects?

We further hypothesize that an AM may be a psychologically powerful tool for re-framing thought patterns and persuasively internalizing information. Given that this is a very fundamental task of the



The concept is agnostic to its implementation. An AM need not rely on implantable devices or whole robot bodies; for example, it might be as rudimentary as a set of basic wearable sensors, augmented-reality goggles, and a robot arm—or simpler still.

A NEW RESEARCH PROGRAM

As this variety of embodiment is essentially unstudied in HRI,

¹ That is, the concept is rooted in a *non-dualist* rejection of Cartesian mind-body separation, and does not rely on monism or panpsychism; it denies a strict division without asserting a single underlying substance or that all physical systems instantiate cognition.

human condition, the consequences would thus be extensive and far-reaching. We imagine potential applications in domains such as mental wellness, general problem solving, and, in the case of AMs linked together and allowed to “share” thoughts, communication.

A SPECULATIVE SOCIOTECHNICAL DESIGN

In science fiction, the idea of blurring the boundary of the self—of merging humans and machines together into more cohesive entities—is, more often than not, presented as something sinister or beyond the mundane. This tends to be the case whether it’s a kind of unmooring of one’s humanity (such as the merger of the Major and the Puppetmaster AI in *Ghost in the Shell* [15]), a dystopian authoritarian stripping of agency (such as the mind-linked Sunlit police force of *A Memory Called Empire* [14]), or outright body-horror (such as the Borg of *Star Trek*). Even in reality, we already see a tendency towards more violence-oriented imaginaries of the idea in, for example, literature on human-AI teaming for expressly militaristic applications [21]. This sort of advancement is framed as a natural inevitability of technological progress, yet: is it? [7]

Here, we want to push back on this seemingly “inevitable” cyber-horror future with a speculative vision of a brighter one: one where the dissolution of the human-machine boundary is still weird, mysterious, and exciting, yes—but perhaps not so different from the mundane ways in which we have always interacted with technology. We envision a world where this kind of technology might help connect us with ourselves, with nature, and with each other. We imagine a sociotechnical future that might just be worth working towards—one that is grounded, imbued with meaning, and, dare we say, a touch whimsical.

Through speculative sociotechnical design, we may take the imagined futures our research tacitly constructs and instead make them explicit so that we might more conscientiously direct them. In line with Winkle’s establishment of speculative sociotechnical design as an HRI practice distinct from design fiction [20], we do not concern ourselves with the exact technical implementation of an AM. Its interfaces might exist as something wearable or implanted; powered by batteries, sunlight, or our own biochemistry; it might be driven by the kind of algorithms we might recognize today, or perhaps by something we have yet to discover. What we do name, though, are its abilities from the perspective of an individual interactant: most importantly, the ability to produce artificial “thoughts” in the mind and to stimulate the senses to artificially produce various sensations throughout the body. The AM can be connected to robots to extend the body, and multiple persons’ AMs might be connected to each other—directly blurring the boundaries between human, robots, and individual mind-bodies.

HUMANISTIC HRI: POETRY AS PRACTICE

To explore this speculative future, we take an approach that is both novel and ancient. For thousands of years, we have used poetry as a means of sharing our innermost feelings and experiences. Bardzell & Bardzell advocate for a humanistic HCI practice, analyzing interactions through a lens of critical literary analysis [1], and this naturally may encompass the usage of poetry [2]. Here, we bring this to life for HRI in a very direct way. Through poetry, we attempt to capture the inner experiential quality of interacting with and through an AM in three separate imagined scenarios.

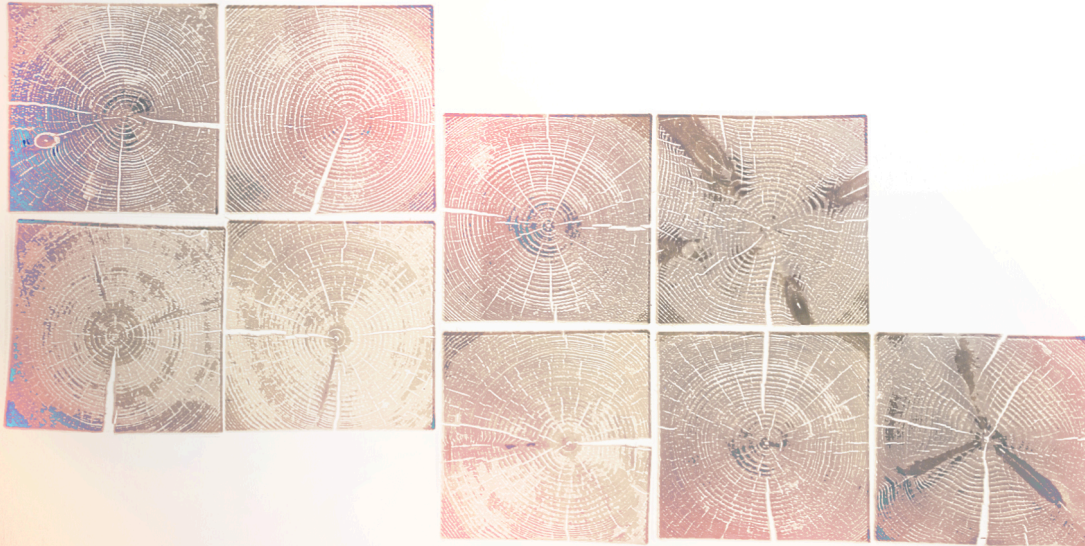
Each scenario highlights the potential ways in which an AM might influence human-robot, human-nature, and human-human connection, respectively. This is in line with a philosophy where, rather than merely making tech to “solve a problem” or see what is a logical next step in terms of sheer feasibility, we instead forefront the answer to the question “How should the technology make us feel?” as a core guiding design principle. In the spirit of feminist HRI, we choose to focus not just on the embodied experience of individuals, but also of families, communities, and ecosystems. Further, inspired by *Concrete Mathematics* [22], a textbook which utilizes marginalia from readers to evoke greater relatability and explication to even dry mathematical concepts, we lay the collective writing-and-analyzing process visually bare through showcasing marginalia that exhibit two readers’ immediate felt reactions.

Each poem and corresponding scenario was written by the first author (LM). Each poem was printed and distributed to the second (GC) and third (KW) authors, where they were encouraged to handwrite in the margins and share their reflections. LM then collated the annotations into a digital format. We first present each poem and scenario unannotated so that the reader may first experience them without bias. For accessibility, we include audio performances of each poem linked throughout. Finally, in this day and age, it is worth noting that these poems were written without any assistance from large language models. All poems are written in common metre (paired alternations of iambic tetrameter and iambic trimeter) with varied rhyme schemes and words placed freely on the page as spatial evocation. All accompanying visuals throughout this work are human-made through manual illustration and photo manipulation, and were not created using generative AI.

SCENARIO: HUMAN-ROBOT CONNECTION

Two close-knit community members are constructing housing. They stand on the top floor they have built up and are now adding pre-fabricated wooden roof trusses. To do so, their senses and proprioception are jointly “merged” (via their respective AMs) with a small swarm of robots capable of lifting the heavy beams. As they attempt to set the first truss into place, one of the robot’s legs slips and dangles precariously over the edge of the unfinished floor. The merger with the robot swarm allows them to both feel the precarity immediately as a bodily sensation, and, in unison: pause, re-steady the robot, and set the truss in place.

▶ [LISTEN TO THE READING](#)

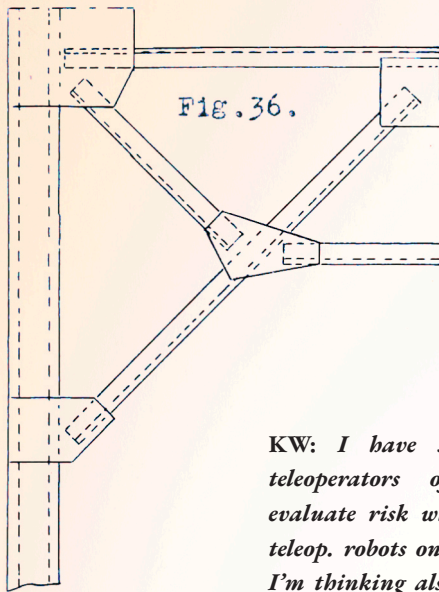


We stretch our arms of skin and tin
—all two, to four, to eight—
to tilt the timber truss and thus
allay ourself its weight.

Yet shame, the morning’s rain became
our certain surety’s thief:
a slip,
a gasp,
our nerves all clenched—
we’re dumb with disbelief!

Our seventh foot is dangling free
in quite a risky state;
Naught waits for it below except
a very sorry fate!

We breathe a breath, we shift our stance,
and, in a time quite brief,
we dance both foot and truss to where
they ought to be—relief!



KW: I have seen work on how teleoperators of nuclear systems evaluate risk when sending (or not) teleop. robots on certain paths [4] — I'm thinking also of the soldiers who might get hurt rather than "sacrifice" their robots [5] — what's the impact of feeling the robot as extension in this direction?

KW: How little we make space for pause + bodily experience in typical HRI work!

KW: => I note that this was rather whimsical in delivery, but also note that I was quick to see "risk"—risk of overtrust, or of harder to deal with consequences if the robot foot fell. The fear is real, but so is the potential for joy.

GC: The use of the plural evokes these perceptions, emotions, and questions for me: Disturbing. Mind-blowing. Threat to human identity. Curiosity. What is human agency here? What does it mean to be human? [Are we] losing our humanity?

We stretch our arms of skin and tin
—all two, to four, to eight—
to tilt the timber truss and thus
allay ourself its weight.

Yet shame, the morning's rain became
our certain surety's thief:
a slip,
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our nerves all clenched—
we're dumb with disbelief!

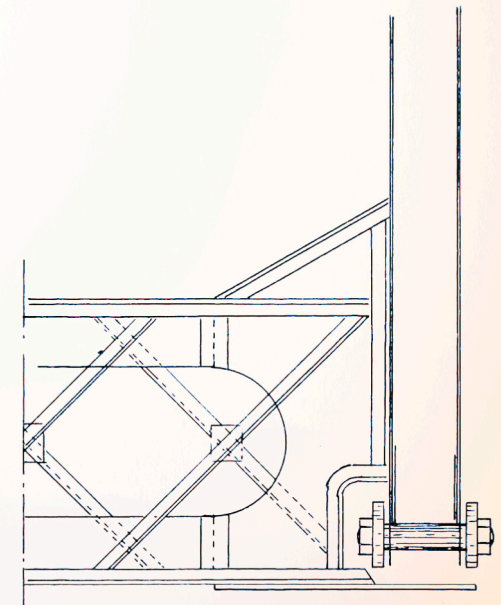
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Naught waits for it below except
a very sorry fate!

We breathe a breath, we shift our stance,
and, in a time quite brief,
we dance both foot and truss to where
they ought to be—relief!

KW: There is something evocative here about skillful movement. Prev. work on dance for HRI [23]. But also skilled work & work-pleasure [20]

KW: Connects to questions around lab-based HRI studies & designing for the "real world"

KW: We have such limited HRI work on dealing with "failures" even as we know there is often an overconfidence w/ robots— (how) will that overconfidence manifest differently when the robot is an extension of the self?



The symphony of pattering,
fresh rain on forest greens:
It's great for calming nerves, although
quite poor for seeing things!

I skip
among
the mossy
stones
and cordial ancient pines
with minds both fixed to tracking down
some certain scrumptious finds.
And, suddenly, a twinkling in

the corner of my sight:
A precious gem amidst the brush—
what mushroom,
what delight!

Though this mind does not know its kind
the other surely does:
What should be foreign, fearsome teeth
all turn to friendly fuzz.

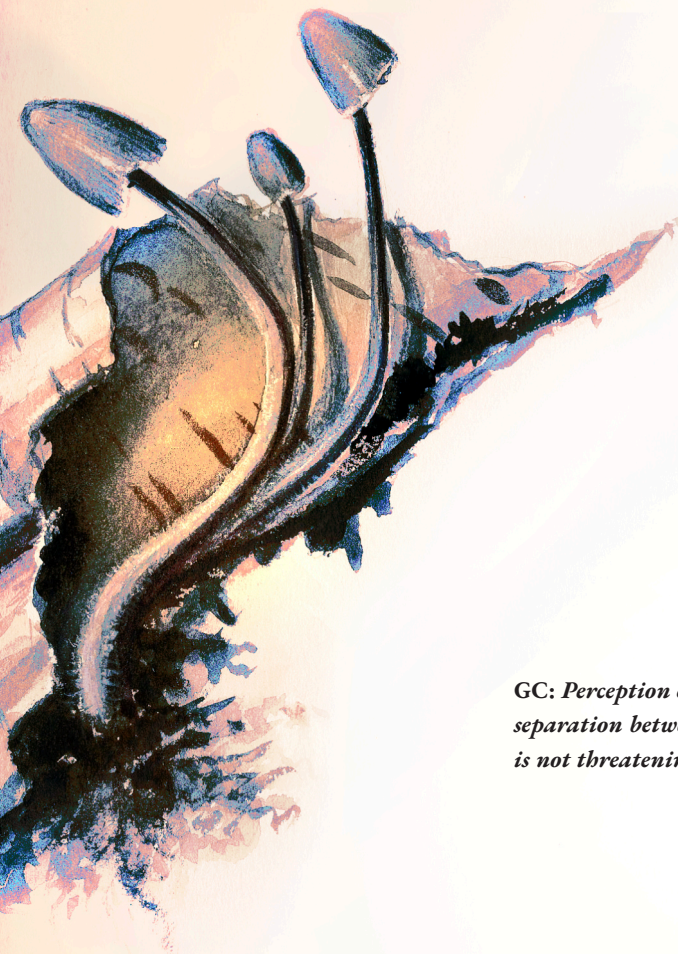
A flash (or three) of recipes:
a stir-fry; stew; soufflé;
The kind of meal to bring friends near
—What luck I have today!
It's quick to pick and mine to keep
—thought maybe not yet taste.
I'll first consult my wiser friend
(for safety—just in case!)

SCENARIO: HUMAN-NATURE CONNECTION

A lone intrepid forager treks through the forest. It's raining, and visibility is reduced — perhaps the same morning precipitation that befell the house constructors? He uses his AM to assist with spotting edible mushrooms through the spray. It spots just such a fungus and marks it with a twinkle in his field of vision. Upon going to pick it, he realizes it is a variety he has never seen before. The AM, however, allows him an artificial familiarity with the species, to know that it is edible and delicious, and to already imagine three different recipes that he could cook it into. He pockets the mushroom, but not without due caution: knowing the risk (however small) that the AM may have misidentified the species, he resolves himself to verify it with a more mycologically versed friend before attempting to eat it.

◀ [LISTEN TO THE READING](#)





GC: Familiarity with personal experiences; connection with nature;

GC: Perception of separation between minds is not threatening

GC: Happy to see that human agency and oversight are preserved

GC: *AM as enhancement, augmentation of human capabilities.. . Beyond human design... Positive tone...*

The symphony of pattering,
fresh rain on forest greens:
It's great for calming nerves, although
quite poor for seeing things!
I skip
among
the mossy
stones
and cordial ancient pines
with minds both fixed to tracking down
some certain scrumptious finds.
And, suddenly, a twinkling in

the corner of my sight:

A precious gem amidst the brush—

what mushroom,

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Though this mind does not know its kind,
the other surely does:

What should be foreign, fearsome teeth

all turn to friendly fuzz.

A flash (or three) of recipes:

a stir-fry; stew; soufflé;

The kind of meal to bring friends near

—What luck I have today!

It's quick to pick and mine to keep

—but maybe not yet taste.

I'll first consult my wiser friend

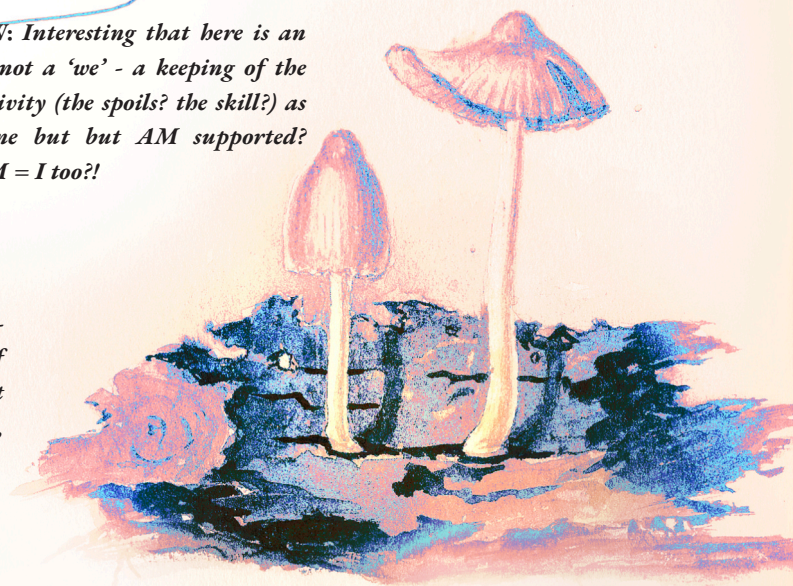
(for safety—just in case!)

KW: *I don't know if I know of any work on or in HRI for/with/and nature?? Only agriculture, maybe?*

KW: *The best kind of sci-fi! a thing I could imagine really wanting + this wholesome link to social outcomes it affords!*

KW: *Interesting that here is an 'I' not a 'we' - a keeping of the activity (the spoils? the skill?) as mine but but AM supported? AM = I too?!*

KW: *This feels like such an exercise in AM for "work-pleasure"!! I love it; it felt like a wonderful balance of supporting the forager in their "task" without detracting from the pleasure of the "task" (hobby, activity). More of this!!*



If speaking were as simple as reciting prompted words,
I would not be so far from home. They would not need me here.
The thrum, beat, thrum of anxious pulse: my chest becomes a drum.
I'm standing in the shadowed wing—the threshold just beyond.
My boots are polished black and sharp lapels pressed neatly flat.
How many thousand piercing gazes can this armor take?—

a sharp inhale,
a pause,
an ease,
a warm familiar hand,
a steady firmness on my shoulder,
felt,
but not quite seen.
A voice, I know it well,
like sweet mulled wine and crackling hearth:
“You’ve spoken greater fire to crowds less merciful, my heart.”

Exhale.
I smile.
How is she always right?

The tension lulls,
not all the way,
but just enough
to step into the light.



SCENARIO: HUMAN-HUMAN CONNECTION

A well-regarded government minister prepares to give a big speech in a land distant to her own. Despite her prowess, she’s feeling quite the case of stage fright. She doesn’t need to worry about remembering the words—her AM is there to prompt her if she needs it—but she is wary of the sheer number of eyes about to be on her. At once, she hears in her mind the voice of her wife of twenty years, reminding her that she’s already successfully handled higher-stakes speeches in the past. This is accompanied by a sensation as though her wife’s hand rests firmly on her shoulder, soothing her and bolstering her confidence. In this instance, the two have allowed their AMs to be linked and are capable of a kind of psychosomatic messaging. Her loved one is on the other side of the world, yet still there with her in an intimately supportive way.

🔊 [LISTEN TO THE READING](#)

GC: *Very relatable human experience*

If speaking were as simple as reciting prompted words,
I would not be so far from home. They would not need me here.
The thrum, beat, thrum of anxious pulse: my chest becomes a drum.
I'm standing in the shadowed wing—the threshold just beyond.
My boots are polished black and sharp lapels pressed neatly flat.
How many thousand piercing gazes can this armor take?—

GC: *Gives a good impression of how the AM works*

a sharp inhale,
a pause,
an ease,
a warm familiar hand,
a steady firmness on my shoulder,
felt,
but not quite seen.

KW: *I am thinking a little about the work on robots for facilitating connection between loved ones, for example family health sharing -- where the robot helps us reach out for support when we would otherwise just avoid "being a burden" (which doesn't help anyone!)*

A voice, I know it well,
like sweet mulled wine and crackling hearth:
"You've spoken greater fire to crowds less merciful, my heart."

GC: *Human connection. Love. Courage. Hope. Care.*

Exhale.
I smile.
How is she always right?

The tension lulls,
not all the way,
but just enough
to step into the light.

KW: *There is something comforting about retaining some discomfort, like this isn't about "turning off" or drowning out the nerves. What is it to design for "appropriate discomfort"?*

GC: *Clear benefits to humans by tech*



REFLECTIONS

Here we present the reflections by GC and KW as written immediately upon engaging with the poems. The reflections are unedited outside of inserting references where appropriate. A meta-reflection by LM follows.

REFLECTION BY KW

The human-nature poem resonated so strongly with me as depicting the kind of human-machine future I would like to be working towards with my work—the design for work-pleasure in terms of not detracting from/automating the activity and the justification of technology use for “hobbies” (particularly nature-based ones), the “trustworthy AI” component in the planned checking of the mushroom identification—it ticked all the boxes for me. Recently, I have been thinking a lot about our “motivating use cases” and perhaps starting to critique a little what motivating use cases we are leveraging and why; I would love to see more use cases which represent these joyful, meaningful activities. If you what you really need to do is test a vision algorithm’s ability to classify under non-lab conditions, why not go do it in a forest where there might be moss and rain and fog (c.f. also the human-robot connection)?

Per my annotations, I was a bit surprised at how quick I was to see risk and possible negatives in the human-robot connection poem—concern about how scary it would be to experience that risk of failure (and hence our responsibility in designing a system that might afford/induce that); concern about people “sacrificing” themselves to save their robot teammates (although I get that this smacks of anthropocentrism and perhaps does not do justice to the strength of any AM-human body-robot body connection supporting one sense of “self”). I still saw the joy in it—I was curious about how it would feel to be part of a synced

unit, but that also had some negative undertones (perhaps I was thinking in a Borg-like direction, but less in the “evil purpose” and more in the “(how) would I maintain my sense of self under these conditions?”). Perhaps, though, this is a consequence of working on risk of anthropomorphism/human-robot connection in the past.

REFLECTION BY GC

[On her HRI praxis:] I work towards a future where technology benefits humanity. I aim to promote an approach to AI development that puts humans at the centre and is guided by ethical principles of respect for human autonomy, prevention of harm, fairness and explicability to improve individual and collective wellbeing. In the poems I find elements of both alignment and clash with this vision.

Augmenting vs. replacing or altering to the core human qualities: I perceive the human-human and human-nature connection scenarios as supporting the former, while the human-robot connection scenario evokes strong concerns about the latter.

The embodied and experiential qualities of the poems enable a new experience of imagining possible futures. They make it clear that science fiction science approaches (see Rahwan et al. 2025 [17]), such as the one adopted in this work, are a necessity to understand potential impacts of a technology before it is mature or deployed, and also to conduct foresight exercises that are the core of proactive regulation efforts.

The scenarios for the human-nature and the human-human connections are very relatable and familiar. It is clear to see how technology may enhance / augment human capabilities, without altering what is perceived as being human to the core. I found the human-robot connection scenario disturbing.

The perception of hope and critique align with the ideas of augmentation to benefit humans vs replacement or alteration of core human qualities, respectively.

META-REFLECTION BY LM

I am very happy to see that my poems largely communicated what I was hoping for. I was surprised by the negative reactions garnered by the human-robot connection poem, yet I also think that these sorts of reactions are the most valuable for guiding our attention to the sensitive things that need work.

An experience that I was attempting to capture in the first poem is the satisfaction I feel when moving in synchrony with members of my rowing team to carry boats into the water and row them in smooth, gliding courses. While there’s a certain dissolution of individuality that occurs during this, I think as an example it also has some lessons to draw on in terms of preservation of human agency that didn’t quite make it into the poem. In rowing, participation in the synchronized crew is always voluntary, and, while not expected to always be comfortable, it is never meant to be painful or dangerous. Submission of one’s individual freedom of movement to the synchronized boat crew is always only for short periods at a time. In the case of pain or threats to safety, this is communicated, the boat stops, and synchrony is paused. These might be the very sort of social and technical guardrails that the system presented in the poem would need in practice.

As for the risk of falling off the floor? Perhaps a simple tether would do!

IS THIS HRI?

Whether this whole endeavor has been “HRI” is something that we, three self-identifying HRI researchers, have been grappling

with. While robots and human-robot interaction are undeniably central to the AM concept, it also stretches beyond—evidenced by the second and third poems not featuring robots at all. Yet, it has emerged directly from our HRI research and remains steeped in HRI literature. Perhaps fittingly, the boundary-blurring nature of the AM also seems to blur boundaries between disciplines. We feel that there is something “HRI-important” in this boundary-blurring, as HRI has long grappled with questions of when, how, and why to distinguish itself from HCI—and we hope for this work to mark a worthy continuation of the discussion.

FUTURE WORK

This exercise has uncovered both opportunities and risks for further exploration of the auxthetic mind-body concept. For risks, questions of the preservation of human agency and overtrust seem especially salient, and we should remain diligent to address them as we seek out the brighter AM outcomes we imagine. We hope that this work might also serve as an addition to the new canon of speculative sociotechnical design for HRI—not just in its own right, but also as an unexpectedly practical “first step” to imagining what sorts of futures we might set ourselves barreling towards when we set out to explore a new technology. The work ahead for exploring the AM, certainly, seems endless. The road ahead is long, but it might just be twinkling.

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source photo on page 8, taken in her dormitory in Kyiv, Ukraine. The graphic on page 2 is an original illustration by Lux Miranda, and we thank AdorkaStock on DeviantArt for the pose reference. We honor the work of Annie L. Prat (1860-1960), whose exquisite botanical illustrations are featured in manipulated form on pages 6 and 7. The truss illustrations on page 5 are sourced from Paul Jervis's 1910 bachelor's thesis, *Details of railroad truss-bridges*. The manipulated violet illustration on page 9 is sourced from Homer D. House's *Wild Flowers of New York* (1918). Page 4 features a manipulation of *Wooden beams* (2008) by Tony Hisgett (licensed under [CC BY 2.0](#)). We thank [Chris Abney on Unsplash](#) for the source photo of the header on page 1, [Mitchell Luo on Unsplash](#) for the source photo of the footer on page 12. Thanks also to the Wallenberg AI, Autonomous Systems and Software Program — Humanity and Society (WASP-HS) for valuable conversations and collegial support

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