Languaging, participatory technology, and becoming: reflections on crisis conditions and open futures

Elena C. Cuffari[1*] and Sébastien Lerique[2]

[1] Franklin and Marshall College, Department of Psychology, Lancaster, USA

[2] Independent Scholar

[*] *Authors contributed equally to this editorial.*

Introduction

Scientific understanding of language, along with its emergence and its evolution, is currently undergoing major theoretical and empirical shifts. Indeed, since the middle of the 20th century, mainstream approaches to explaining language were strongly influenced by the computational metaphor of mind (Gigerenzer & Goldstein, 1996). As cognition was mainly seen as information processing of sensory inputs for continuous inference, language could be seen as the manifestation of a set of formal symbolic and logical structures, with corresponding hardware to process such structures in the brain. Relevance Theory (Wilson & Sperber, 2004), for instance, relies on a hypothesized logic-processing "device" in the brain (e.g. a brain area or nucleus) capable of rapid inference of the relevant logical entailments of an utterance in a given context. Approaches in this area share a common core object of study: the individual, and its capacity for inference based on information provided by a given context.

Since the end of the 20th century however, the computational metaphor has been increasingly challenged: while the brain undoubtedly implements many information processing mechanisms, taking such capacities to be the core of cognition has led to dead-ends and an impoverished view of the full breadth of activities of the mind. Together with Cognitive Linguistics, the so-called "4E" approaches have reconnected the study of language with the concrete constraints and affinities provided by the body and its interactive context. The Enactive approach, in particular, extends Varela et al.'s work (1991) to develop an explanation of language and meaning entirely grounded in the materiality and dynamics of interactions (Di Paolo et al., 2018). By starting from the dynamics of interacting pairs, this theory identifies a fundamental tension that exists between individual-level goals and the higher-order dynamics of the interaction taken as an emergent system (De Jaegher & Di Paolo, 2007). Having to manage such tensions—and eventually transforming them as participants become sensitive to such higher-order dynamics—generates a constant pressure for the emergence of structure in interactions. This pressure paves the way for the gradual emergence of linguistic patterns in interactions (Di Paolo et al., 2018). Languaging, rather than language, is thus a particular way of engaging with others and the world around us, and pervades all levels of action and perception. This theoretical move is paralleled by the growth of experiments in Perceptual Crossing (Froese et al., 2014, Lerique et al., 2024), Iterated Learning (Carr et al., 2017) and Experimental Semiotics (Roberts & Galantucci, 2017), which look for the emergence of structure in

communication mechanisms due to interaction dynamics and the evolution of individuals' points-of-view and perspectives.

A similar shift is happening in technology and the field of human-computer interaction, as a growing number of technologists agree that current computing systems overly privilege the individual in structure and design. Combined with the restricted interactions that screen-based interfaces afford (Victor, 2014), these tend to isolate people from one another instead of supporting interactions and helping them deal with alterity (Fletcher-Watson et al., 2018). In reaction, group-level interaction-centric systems with rich tangible and malleable interfaces are being designed (Victor et al., 2024) with the aim to support collaborative interaction with diverse participants, and explore their emergent dynamics. Instead of isolating individuals into bodily inertness, and submitting users to the tyranny of unfathomable inner workings, these alternative systems are designed to support users in navigating interactions with other people and with their own thought processes, as well as enabling genuine literacy as regards the inner workings and modifications of the system itself (Victor et al., 2024; Amelang et al., 2012; Illich, 1973). The HCI community develops a parallel line articulating the link between technology, embodiment and diversity, looking at how technology can be designed to support interactions instead of nudging people towards isolation (Fletcher-Watson et al., 2018; van Dijk and Hummels, 2017; Bennett et al., 2021). The parallel between such interaction-first, diversity- and group-aware systems, and the move to theories of language based on the dynamics of interaction, is striking, so much that cross-pollination and collaborations should be fruitful.

The development of interaction-first and group-aware aspects (Dingemanse et al., 2023) can be seen in many other disciplines, be it in anthropology (Becker, 1996) or even in law research (Supiot, 2019). Yet, the state of tech today, and the direction of mainstream technological development, does not reflect the synergy that is possible with attunement to living, sense-making bodies. Today's technology is not built to serve communities' needs, but to fill corporate pockets. Appearances of interaction-affording tech mask deep, fundamental differences between human cognition and current computing architectures. As a form of interaction, languaging develops in and is supported by the environment in which people are embedded, suffused with technical and technological objects and practices. Technology, in other words, affords a milieu in which interactions and languaging occur. Yet current technological systems, and particularly personal computers and smartphones, are built for the brain in a vat, thought from the ground up as symbol-manipulating systems, and effectively restricting our relationship to machines (and through them to other humans) to minute finger movements in front of a small screen filled with symbols (Victor, 2014). While machine-recognized gestures, voice commands, or bewildering chatbots such as ChatGPT and its LLM family may make us dream of broader body-machine interactions, the dynamics that such implementations open remain detached from languaging itself (if not from language). They are designed for individuals instead of interactions between people, based on static meaning spaces instead of genuinely open-ended perspectives, and generative of a hierarchy between users on one side, and providers or creators of the available meaning space on the other. Accumulating enormous software and material complexity, on top of which application layers have been purposefully designed for generating addictive behavior, such systems not only ignore fundamental features

of bodily interaction, but foreclose any possibility for agency or literacy at the level of the milieu that they generate (Fletcher-Watson et al., 2018).

Indeed, while laptops are easily recognised as physically static objects, we often consider the *inside* of a computer to be profoundly dynamic, supporting our becoming and our interactions. Yet simple examples show the maintained gulf between technology and languaging.
Programming languages, for instance, have a static syntax at the root.
While programming languages are often if not constantly updated in terms of syntax, compilation procedures, and compiler implementations, a program remains by definition—and by necessity—executed as CPU "native code": the static syntax representing the actual steps that a CPU architecture can execute. Thus no matter the input provided, the existence and evolution of higher-level syntaxes[1], the complexity in design, the addition of randomness or of live, physical measures, executing a program remains a pre-defined, inherently static execution—be it only pre-defined in the preceding CPU time step (Frank et al., 2024, chapter 3). As stated by Parrish (2016), "The world, which consists of analog phenomena infinite and unknowable, is reduced to the repeatable and the discrete". Stability was indeed one of the original aims of such a design.

In other words, instead of a tool *enabling* a task, or a third person *supporting* an interaction, technology has become a *society-wide medium* built from its root as a static store, with static definitions of what *content* would be, itself *transmitted* through static channels. None of these observations depend on the software or implementation levels: they are physical facts of hardware, true for all mainstream hardware architectures, including AI and LLM.[2]
This blind spot (Frank et al., 2024, chapter 7, section *The Computational Blind Spot*; similarly to seeing a skyscraper as a mountain, Ingold, 2015, chapter 7), having led society to perceive technology as dynamic, seems to have brought us to work more exclusively *in* instead of *with* the digital world itself. We now rely daily on digitally encoded, static representations of what we would otherwise have used—interacted with—in the physical world. This has obvious costs: we enact in the digital space most of the time—if not exclusively. It becomes a realm that constrains

---

[1] An action which itself can be recursive, whose compilation and execution time scales can be minimised, and therefore which could hypothetically include live external information in its syntax (a frequent operation is the "Just-In-Time" compilation, or JIT: a section of code compiled just before the moment during which it is executed).

[2] Like any software, AI and LLM are necessarily based on a "content" notion—be it for training or for processing a request, request itself provided as an instance of such content definition—, with a static limit to what such content can be. As described by Frank et al. (2024, chapter 7, section *The Computational Blind Spot*):

> Just as AlphaGo has no knowledge that its data structures pertain to a game in the world, and ChatGPT (an AI chatbot built on LLMs) has no knowledge of how the world works, face-recognition systems have no knowledge that their data structures pertain to images of faces, let alone real people who exist in the world.

In other words, the minimal step out of this would be dynamic *hardware*.

us and our children, leaving aside our environment, its physical space, if not even a part of our approaches to metaphysics.[3]

While each of these blind spots—the idea of "language" hiding our actual languaging, and our daily dependence on current technology letting us imagine it as interactive and dynamic—has been criticised in detail (for languaging: Di Paolo et al., 2018, Evans & Levinson, 2009; and for computing: Di Paolo et al., 2022, Frank et al., 2024, chapter 7), bringing them together opens an entirely different dimension.

Prehistory of the article collection

In writing his dissertation (Lerique, 2017), Sébastien was gradually recognising the wall in front of which he was then stuck, attempting to mathematically model re-interpretations of utterances, changes of paths, like linguistic bifurcations, that may occur when someone relies on or transmits some utterance someone else pronounced or wrote. Ingold's critique of the notion of static language (Ingold, 1999, 2001) was a breath of air, helping to recognise the fundamental cross-person dynamics of life (as implicitly or explicitly adopted decades ago by Gibson's Ecological Psychology, Merleau-Ponty's phenomenology of the body, bodily rationality as in Gallagher, 2018, or Malafouris, 2013), and of language, in other words *languaging*, as Elena Cuffari et al. had started to describe in detail (2015). Indeed, the Enactive approach has pushed cognitive linguistics and gesture studies to recognise how dynamic, collaborative, messy and humane the activities that bodies do together are. While approaches that combined and compared the dynamics-based and information-based models of interactions were a very helpful step (Beer & Williams, 2015), the actual tools used to describe most of today's research—that is, our computers and keyboards—began to show its actual non-negotiable constraints, in contradiction with the languaging that was described in such publications, themselves thanks to computers.

The second jump that started unlocking this invisible contradiction was by coming across Bret Victor's proposal of a different, interaction-based usage of existing technology: Dynamicland. As mentioned above (Introduction), Dynamicland emerged from the observation that individual screen-based interfaces become an obvious constraint when compared to the richness that interactions can develop—just consider face-to-face interaction dynamics with a physical shared table as a support—linguistically or not (Victor, 2014; Victor et al., 2024; Harris, 2023, chapters 3.4, 5.3; Illich, 1973; Morozov, 2024; De Jaegher et al., 2017). The first steps forward are quite simple, and the challenge becomes the number of doors that pop up when following this path.

Instead of an individual screen, a videoprojector and a camera—both connected to the same PC—hang from the ceiling to point down towards a physical table. From there:

[3] AI's marketing often triggers discussions about how General AI's could have some agency, if not some consciousness.

1. On the table, sheets of paper printed with coloured codes in the corners are recognised by the system's camera. The computer then executes the code associated with the sheet it detects, and projects its output onto the same sheet of paper.
2. Each sheet is informed of the position of the other sheets, which they can react to. For instance, having one large sheet with a map displayed on it, a smaller sheet can have the map add the bicycle lanes, or hide them when the small sheet is hidden. More generally, all sheets of paper can access all the input that the system processes—positions and movement of other sheets, "wishes" or "declarations" produced by sheets—, and interact with each other.
3. Keyboards become one of the many possible inputs recognised just like sheets of paper: when pointing towards a sheet, that sheet's code is projected and can be edited live. This last step frees the system from using screens at all: once a bootstrapping system is launched, it can be edited directly on paper sheets on the table, with a keyboard pointing towards each sheet. Similarly to programming languages edited live during execution (e.g. Scheme), from there on the system's code can be gradually updated and replaced step-by-step by the code of the sheets of paper themselves.

Similarly to the way the opposition between language and languaging can become obvious given the right context, Sébastien was lucky enough to come across the Dynamicland project during a postdoc focussing in another—if not opposite—direction: deep learning.[4] Now, as the stronger a contrast the harder it is to deny it—that is, the easier it becomes to accept the surprise it can trigger—, the gulf between the languaging approach and the notion of language was quickly paralleled with the gulf between our daily use of technology and the approach proposed by Dynamicland. As Bret Victor began to explain his motivation to an audience of software engineers, "Ideas are very precious to me and when I see ideas dying it hurts. I see a tragedy. It feels like a moral wrong, an injustice. If there is something I can do about it then it feels like a responsibility for me to do so. Not an opportunity but a responsibility". In other words, a nobility, a support or service for, or a taking care of.

The simple way out of such a "tension of tensions" was to help each of the unrecognised or unaccepted approaches to meet each other, in a workshop aiming to investigate such a parallel.

Sébastien therefore organized a workshop that was held in February of 2020 at the University of Lyon. "Embodied Language and the Dynamic Medium" aimed to bring together communities that, while currently disconnected, share an interest for the complexity that emerges through the dynamics of interaction, as well as its effects at large scale (such as the emergence of language, the processes of collaborative understanding that can be supported by computer systems, or the diversity of the network of people which such emergent processes rely on). The goal was precisely to create links between disciplines for the study of this common object. Elena Cuffari, Mark Dingemanse, Omar Rizwan, and Jelle Van Dijk were invited to give keynote addresses, speaking respectively about:

[4] The goal being to technically link a network's structure (e.g. one's friends in social networks) and the types of digital contents flowing in such a network (e.g. actual posts or tweets; Lerique et al., 2020).

- A more accurate and humane ontology of bodies, based on an account of the continuity between humans, language, mind, and the notion of life itself; it combines a theory of bodies with an intersectional and dialectical approach to managing tensions that emerge from the entanglement of diverse bodies (Elena C. Cuffari, Language and the Future of Bodies)
- The way human language can be seen as the ultimate flow of interaction that enables individuals with separate bodies to achieve joint agency, without giving up behavioural flexibility and social accountability—all of which debates the interests in brain-to-brain interfaces (Mark Dingemanse, Brain-to-Brain Interfaces and the Role of Language in Distributing Agency)
- An introduction to and an inside view of the Dynamicland project, including philosophical, technical and social goals and realizations (Omar Rizwan, Humane computing in Dynamicland)
- A Philosophy-through-Design approach, developing a critical perspective on social normativity's pervasiveness in the organization of society, seeking to understand the particular ways in which present-day technologies mediate such normativity in people's everyday lives (Jelle van Dijk, Designing for a Diversity in Sensemaking)

The connection between participants was lively, all of us eager to pursue connections between enactivism, interaction dynamics, ethical design and implementation, which led us to plan a special journal issue.

History of the article collection: 2020-2025

Given the aligned interests and commitments that generated this collection, we would like to offer a brief comment on what happened between the workshop and today, as two major world developments took place that proved to be highly relevant to our project.

When Elena left Lyon to return to the U.S. at the end of the workshop, at the airport her passport received a special sticker indicating that she had not been to China. Within weeks, the world was in lockdown. The COVID-19 pandemic stopped time, then warped it.

During the lockdown millions turned to their screens, for seemingly everything: work, school, groceries, therapy, family check-ins, weddings, funerals, risk calculators. The technology was abundantly useful, offering these chances to connect, which in many cases provided the only portal to the world of human contact for long stretches of time (but not for essential workers). We were isolated and had to stay far away from each other, but we could call, see faces, talk. Yet video-mediated communication also had limits that became painfully obvious. We couldn't just walk next to each other and listen to what's going on in the street, couldn't wander without talking to each other, just being together. What everybody wanted was not to touch keyboards, but to have a hug. As Carel et al. (2020) wrote, in a paper advocating for phenomenological reflection on the experiences of social distancing early on in the pandemic lockdown, "embodied interaction with others is an essential foundation of human experience, then the unprecedented disruption of such interaction is likely to have a destabilising effect." Poignantly, they opened the

piece like this: “One of our children, age 7 years, was asked if he wanted to talk to his friends online. “No!” he replied angrily, “what's the point if I can't touch them!?” We couldn’t escape that this medium was a *mediator* in our interactions. It felt awful. Useful, yes, but so, so insufficient.

In this period of years, the editors and contributors to this issue, like countless people around the planet, knew experiences of illness, relocation, existential and economic uncertainty, and ongoing geo-political tumult. This slowed us down, but it also kept drawing us back to the pressing need to reshape, or reroute, our shared future in technology. And this brings us to the second salient global development of the past years: generative AI. Though AI development has been in the works for more than fifty years with plenty of big moments and disillusioned winters along the way, 2020 saw the release of Open AI’s GPT-3, 2021 introduced multimodal image generators like DALL-E, and 2022 delivered ChatGPT, and the versions keep coming. Generative AI was anticipated in talks and conversations at the ELDM workshop; it naturally became an even more urgent interest addressed in a number of papers in this special issue.

Articles in this collection

The collection of papers spans philosophy, linguistics, design, psychology, and computer science. These works showcase the central place of enactive principles in this discussion, the humane potential of studying human cognition by starting with interactions, and the improvements in design for all that are achieved when scientific communities recognize the real diversity of living bodies.

Birhane & McGann (2024) directly apply linguistic bodies theory to the rise of text-generating artificial intelligence, arguing that without embodiment, participation, and precarity, LLMs are not agents, and without agency, there is no language taking place. They helpfully identify the conceptual confusions that lead to the miscategorization of LLMs as language producers or users: traditional substance metaphysics reifies language and data alike as entities that as such are complete. In contrast, Birhane & McGann argue that language is essentially “a practice in which to participate,” which speaks to the impossibility of its completeness. A practice or process ontology of language in turn belies any completeness of linguistic data; “tokens of verbal activity” are neither the starting point nor exhaustive source of meaning for an enactive analysis of language. They make powerful use of the example of *algospeak*—the use of novel coded expressions to get around automated content moderation—to show that language use is driven by care, urgency, and deep lifeworld context (or common ground) that enables nimble pivots in terms and interpretations. LLMs lack all of these capacities or touchstones that enable linguistic activity and agency, in Birhane & McGann’s view.

From a different theoretical starting point, Druzhinin & Ramirez (forthcoming) deeply consider the nature of LLMs and find their activity poles apart from human languaging. The Russian school of (bio)cognitive ecolinguistics, which follows Humberto Maturana’s structural and organizational philosophy of biology, offers a specific perspective on the ecology of human-technology systems. “What we do as languaging humans provides an ecology that sustains our cognitive living ‘on and on’, enables our further self-production… technologies and LLMs are no exception” write Druzhinin & Ramirez: “...LLMs arise in the cognitive domain of

humans in certain ways," i.e., "as linear patterns of bodily experience interpreted as text aggregated on screen." Text-generating artificial intelligence is a human-created technology meant to operate in and perhaps augment a human cognitive niche. While it can function as part of a system that includes human language users, this does not give the technology agential powers in and of itself. Moreover, its ersatz linguistic nature gives the illusion of explanation to users, and thus in fact threatens to erase experiences of construction and other-orientation for the humans who ask LLMs questions and adopt their answers as such.

De Jaegher et al. (2025) observe that technologies that obscure interactional friction prevent the full range of experience and insight that come from intersubjective meaning-construction, or participatory sense-making (De Jaegher and Di Paolo, 2007). Technology as such is not the issue; their study reports and carefully scaffolds the reader's experience of a participatory research technology called PRISMA. Utilizing a strict protocol of short interactions and notations, three specific modalities of inquiry (sensing, feeling, and thinking), referring to perception, and rotating particular roles, PRISMA *increases* interactors' awareness of the constraints and tensions that make up the dynamics of social interactions. In the PRISMA workshop reported here, participants were given different materials and asked to draw together on shared sheets of paper without speaking. Participants were guided through a process of reflecting on and intervening in iterations of interactions. Their interpretations ("approximations"), and the authors, showed paradoxical practices of being with each other, describing experiences of balancing between opposing forces and qualities in both their individual and participatory moves. Some of these tensions came from the materials themselves; textures and smoothness and colors influenced emotions and emergent sense experience of the interaction. According to the enactive theory of social cognition, this kind of balancing or friction is needed for meaning making to happen. The authors reflect on the value of affording awareness of diversity, difference, and dynamics, writing "intersubjective complexity is something human beings with lifelong experience of interacting with others in some sense already know and that, at the same time, we could do with better understanding, both experientially and conceptually."

Van Dijk & Oral (2025) describe another participatory method, as they involved autistic children, teachers, neurodivergent dancers and music therapists in their research-through-design inquiry into DiaDance. DiaDance is a technology that, unlike many designs for the autistic community, does not seek to erase difference, but rather to enable inclusive relating. DiaDance presents an interaction space that is novel to autistic and non-autistic interactors alike, inviting participant-dancers into dialogical and local rather than social-system governed interactions. The details of how this works and how the authors designed it are worth close attention for their own sake and for the broader principles they generate for supporting dyads on their own terms. Van Dijk & Oral's study is a deliberate step forward for neurodiverse participatory sense-making and supportive technologies.

Two other fascinating studies in the issue consider the social sense-making possibilities of more ubiquitous technological mediations: video conferencing and virtual reality. Harrison (2025) asks what happens to gesture when our social and professional spoken language activities become mediated by a screen. Drawing on phenomenology and gesture linguistics, Harrison probes

how different disciplines determined the criteria for screen-mediated gesture *loss* or *amplification*. Applied linguistics, in particular language testing, and psychotherapy provide two distinct fields of study for Harrison to reveal the nuances and complexities of embodied communication across distance.

Figueiredo et al. (2025) ask what happens to knowing another person in virtual reality encounters. While it might seem plausible for participatory sense-making or knowing-in-connection (De Jaegher, 2019) to be achieved in virtual social spaces via avatars, these authors argue there is a "biological limit to VR experiences," given the "constitutive role of affection in cognitive processes" and "the existential dimension of PSM," which are unlikely to be replicable in virtual environments where avatars cannot feel or die, thus yielding relationship norms and interactive asymmetries that are meaningfully different from the real thing.

Can we language our way to an open future?

In your most positive envisioning of the world in fifty—or a hundred—years from now, what is technology like? What is it providing for people, and how is it used? What is driving innovation? Perhaps the kind of uses we want are already provided by technology that is currently ten years old. Imagine reorienting design and development around community need, rather than a race to improve performance, to produce more and faster. Paying attention to communities can source a diverse range of needs and ideas, of use cases, as we see in Van Dijk & Oral's (2025) case study of DiaDance, in Harrison's (2025) exploration of video-mediated therapy or language testing, and in De Jaegher et al.'s (2025) explorations in diversity-focused interacting.[5] The question we find ourselves asking at the end of this collection is, how do we show that there is a door that can be opened, that technology could be materially, cognitively, regionally and culturally (in other words, radically) different from what it is right now?

Consider laptops once more as an example: like phones, laptops move easily with us, remove the localizability of our tools, and render current technology as (un)noticable as the air that's around us. During a video call, you can bring your laptop to any part of the house and the conversation or meeting can continue. Localization in space is turned virtual once we have laptops and wifi. This pushes us to accept the idea that we could do any task on the laptop; it is a constant part of our habitat. Yet, laptops actually are highly constraining in design, because we can't change them. They are an example of the static technology we discussed earlier: a laptop is predefined, preprogrammed, with apps that are already and finally structured. You can talk at your screen but not hit it as you would a pillow. You message on WhatsApp and you can write or take pics or videos but you can't draw-write. It's the very opposite of poetry. The possibilities for feeling, touching, transforming, for exploring, for unknowability, are simply closed (Lenay, 2018). Current technology seems to be everywhere and make everything possible while in actuality it constrains us, limits us, and channels our behavior, habits, and sense-making.

[5] Beyond the article collection, we see in Yuk Hui's (2022) introduction to the Chinese philosophy of tools possibilities for different designs and different relation to living, re-opening continuums between our tooling and our embodiment.

The other path we envision involves designing technology to be a help, to be in continuum with life, rather than something to which living bodies must submit. Imagine how enriching it could be for technology to be as truly handy and multipurpose as more canonical tools are. The unacknowledged backdrop of hype cycles and debates about whether and how to allow various flavors of AI in the classroom is an implicit, pervasive acceptance of current technology in both its static form and the inevitability of its intrusion in our lives, work, and sense-making, along with out-of-our-hands updates and modulations. Yet it seems ontologically implausible that text- or image-generating AI will come to the point of complex cultural embeddedness and emotional sophistication to engage in things like algospeak (Birhane & McGann, 2024) or knowing-in-connection (Figuieredo et al., 2025). What if instead, advancements in this technology made it possible for humans to spend more time and attention on each other, on resolving our differences, on healing?

In curating this article collection, we propose that languaging matters to these questions; it is the medium in and through which we make our way forward, one way or another. Working to a different future requires an active, collaborative practice of hope, which may take the form of carefully attending to and reframing the utterances typical of a community to favor those that foster possibility and exploration (Cuffari, 2020; Cuffari et al., 2022). As Li et al. (2020) write in their introduction to a new direction for the field of ecolinguistics, "...language is ontologically a part of the bio-ecology." In other words, human becoming is a co-becoming, in continuity with the rest of the living world, on timescales and community scales large and small. Languaging is our practice of becoming (Di Paolo et al., 2018), so languaging both directly affects and is directly affected by the dynamic existence of all. In the words of Druzhinin & Ramirez (forthcoming, this issue), on an ecological view, "linguistic meaning emerges in our couplings with our ever-changing medium as a result of coordinations of experience. Although it appears as a not fully controllable external force to which we must adapt, meaning is a participatory construction we can only sustain." Micro-scale dynamics partly determine macro-scale dynamics as "[t]oday's first-order languaging [i.e., whole-body interactions in the here-and-now] shapes tomorrow's bio-ecologies by shaping human agents, their social relations, and the physical environment" (Li et al., 2020). We began with the premise that language is not an abstract matter of symbolic representations and their rules of combination, but an agential complex of the practices of sensing and sense-making bodies. It follows that people who speak, hear, or sign, gesture, write, converse, argue, and poetize are entangled with spaces and places, with others, with water and air, bacteria and plants, pets and so on, which all make such activities possible and meaningful. Though corporate interests drive us onward down certain narrow paths, we believe it is still possible to face this situation and bifurcate by combining all directions that remain possible (Harris, 2025)—in other words, to stop pretending we are like the machines we build and to instead build machines whose goal is serving communities, not (mis)representing humans.

References

Amelang, D., Borning, A., Freudenberg, B., Kaehler, T., Kay, A., Lunzer, A., Ohshima, Y., Piumarta, I.,

Rose, K., Samimi, H., Victor, B., & Yamamiya, T. (2012). *STEPS Toward the Reinvention of Programming* [Final Report Submitted to the National Science Foundation (NSF)].

Becker, H. S. (1996). The epistemology of qualitative research. In R. Jessor, A. Colby, & R. A. Shweder (Eds.), *Ethnography and human development: Context and meaning in social inquiry* (pp. 53–71). University of Chicago Press.

Beer, R. D., & Williams, P. L. (2015). Information Processing and Dynamics in Minimally Cognitive Agents. *Cognitive Science, 39*(1), 1–38. https://doi.org/10.1111/cogs.12142

Bennett, D., Dix, A., Eslambolchilar, P., Feng, F., Froese, T., Kostakos, V., Lerique, S., & van Berkel, N. (2021). Emergent Interaction: Complexity, Dynamics, and Enaction in HCI. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems* (pp. 1–7). Association for Computing Machinery. https://doi.org/10.1145/3411763.3441321

Birhane, A., & McGann, M. (2024). Large models of what? Mistaking engineering achievements for human linguistic agency. *Language Sciences, 106*, 101672. [part of article collection]

Carel, H., Ratcliffe, M., & Froese, T. (2020). Reflecting on experiences of social distancing. *The Lancet*, *396*(10244), 87-88.

Carr, J. W., Smith, K., Cornish, H., & Kirby, S. (2017). The Cultural Evolution of Structured Languages in an Open-Ended, Continuous World. *Cognitive Science*, *41*(4), 892–923. https://doi.org/10.1111/cogs.12371

Cuffari, E. C. (2020). 11 Language, Habit, and the Future. *Habits: Pragmatist Approaches from Cognitive Science, Neuroscience, and Social Theory*, 245.

Cuffari, E. C., Di Paolo, E., & De Jaegher, H. (2015). From participatory sense-making to language: There and back again. *Phenomenology and the Cognitive Sciences, 14*(4), 1089–1125. https://doi.org/10.1007/s11097-014-9404-9

Cuffari, E., Fourlas, G., & Whatley, M. (2022). "Bringing new life in": Hope as a know-how of not knowing. *Frontiers in Psychology*, *13*, 948317.

De Jaegher, H., & Di Paolo, E. (2007). Participatory sense-making. *Phenomenology and the Cognitive Sciences*, *6*(4), 485–507. https://doi.org/10.1007/s11097-007-9076-9

De Jaegher, H., Pieper, B., Clénin, D., & Fuchs, T. (2017). Grasping intersubjectivity: An invitation to embody social interaction research. *Phenomenology and the Cognitive Sciences, 16*(3), 491–523. https://doi.org/10.1007/s11097-016-9469-8

De Jaegher, H. (2021). Loving and knowing: Reflections for an engaged epistemology. *Phenomenology and the Cognitive Sciences*, *20*(5), 847-870.

De Jaegher, H., Preiser, R., & Cuffari, E. C. (2025). Paradoxical practices of being with others: Some experiential dynamics at play while interacting across differences. *Language Sciences, 111,* 101731. [part of article collection]

Dingemanse, M., Liesenfeld, A., Rasenberg, M., Albert, S., Ameka, F. K., Birhane, A., ... & Wiltschko, M. (2023). Beyond single-mindedness: A figure-ground reversal for the cognitive sciences. *Cognitive science*, *47*(1), e13230.

Di Paolo, E. A., Cuffari, E. C., & De Jaegher, H. (2018). *Linguistic bodies: The continuity between life and language*. MIT Press. https://mitpress.mit.edu/books/linguistic-bodies

Di Paolo, E., Thompson, E., & Beer, R. (2022). Laying down a forking path: Tensions between enaction and the free energy principle. *Philosophy and the Mind Sciences*, *3*. https://doi.org/10.33735/phimisci.2022.9187

Druzhinin, A. & Ramirez, D. (submitted) Large language models and the cognitive ecology of human living. [part of article collection]

Evans, N., & Levinson, S. C. (2009). The myth of language universals: Language diversity and its importance for cognitive science. *Behavioral and Brain Sciences*, *32*(05), 429–448. https://doi.org/10.1017/S0140525X0999094X

de Figueiredo, N. M., Rolla, G., & de Vasconcelos, G. N. (2025). Participatory sense-making and knowing-in-connection in VR. *Language Sciences, 108,* 101705. [part of article collection]

Fletcher-Watson, S., De Jaegher, H., van Dijk, J., Frauenberger, C., Magnée, M., & Ye, J. (2018). Diversity Computing. *Interactions*, *25*(5), 28–33. https://doi.org/10.1145/3243461

Frank, A., Gleiser, M., & Thompson, E. (2024). *The blind spot: Why science cannot ignore human experience*. The MIT Press. http://mitpress.mit.edu/9780262048804

Froese, T., Iizuka, H., & Ikegami, T. (2014). Embodied social interaction constitutes social cognition in pairs of humans: A minimalist virtual reality experiment. *Scientific Reports*, *4*, 3672. https://doi.org/10.1038/srep03672

Gallagher, S. (2018). Embodied Rationality. In G. Bronner & F. Di Iorio (Eds.), *The Mystery of Rationality: Mind, Beliefs and the Social Sciences* (pp. 83–94). Springer International Publishing. https://doi.org/10.1007/978-3-319-94028-1_7

Gigerenzer, G., & Goldstein, D. G. (1996). Mind as Computer: Birth of a Metaphor. *Creativity Research Journal, 9*(2–3), 131–144. https://doi.org/10.1080/10400419.1996.9651168

Harris, M. (2023). *Palo Alto: A history of California, capitalism, and the world* (First edition). Little, Brown and Company.

Harris, M. (2025). *What's Left: Three Paths Through the Planetary Crisis*. Little Brown & Company.

Harrison, S. (2025). More to gesture than meets the (analyst's) eye? Querying the problem of online gestural loss from applied linguistics and psychotherapy perspectives. *Language Sciences, 108,* 101692. [part of article collection]

Illich, I. D. (1973). *Tools for conviviality*. Harper and Row.

Ingold, T. (1999, April). *Three in one: On dissolving the distinctions between body, mind and culture*. http://lchc.ucsd.edu/MCA/Paper/ingold/ingold2.htm

Ingold, T. (2001). From the Transmission of Representations to the Education of Attention. In H. Whitehouse (Ed.), *The Debated Mind: Evolutionary Psychology Versus Ethnography* (pp. 113–153). Berg. http://lchc.ucsd.edu/MCA/Paper/ingold/ingold1.htm

Ingold, T. (2015). *The life of lines*. Routledge.

Hui, Y. (2022). The question concerning technology in China: An essay in cosmotechnics (Third corrected

edition). Urbanomic.

Lenay, C. (2018). Leroi-Gourhan: Technical Trends and Human Cognition. In S. Loeve, X. Guchet, & B. Bensaude Vincent (Eds.), *French Philosophy of Technology: Classical Readings and Contemporary Approaches* (pp. 209–226). Springer International Publishing. https://doi.org/10.1007/978-3-319-89518-5_13

Lerique, S. (2017). *Epidemiology of representations: An empirical approach* [Thèse de doctorat, Paris, EHESS]. https://theses.fr/2017EHES0114

Lerique, S., Estelle, S., Hayashi, S., Leenen, I., Morrissey, B. R., Morrissey, T., Putri, F., Uhlig, K., Zapata-Fonseca, L., & Froese, T. (2024). The ECSU-PCE Dataset: A comprehensive recording of embodied social interaction with EEG, peripheral physiology, and behavioral measurements in adults. OSF. https://doi.org/10.31219/osf.io/6hjfy

Li, J., Steffensen, S. V., & Huang, G. (2020). Rethinking ecolinguistics from a distributed language perspective. *Language Sciences*, *80*, 101277.

Malafouris, L. (2013). *How Things Shape the Mind: A Theory of Material Engagement*. MIT Press.

Morozov, E. (2024). *A Sense of Rebellion* (Vols. 1–13) [Audio recording]. https://www.sense-of-rebellion.com

Parrish, A. (2016, October 7). *Programming is Forgetting: Toward a New Hacker Ethic - Allison Parrish*. Open Hardware Summit 2016. http://opentranscripts.org/transcript/programming-forgetting-new-hacker-ethic/

Roberts, G., & Galantucci, B. (2017). Investigating Meaning in Experimental Semiotics. *Psychology of Language and Communication*, *20*(2), 130–153. https://doi.org/10.1515/plc-2016-0008

Supiot, A. (2019). Le travail n'est pas une marchandise: Contenu et sens du travail au xxie siècle. In *Le travail n'est pas une marchandise. Contenu et sens du travail au xxie siècle: Leçon de clôture prononcée le 22 mai 2019* (pp. 9–59). Collège de France. http://books.openedition.org/cdf/7029

van Dijk, J., & Hummels, C. (2017). Designing for Embodied Being-in-the-World: Two Cases, Seven Principles and One Framework. *Proceedings of the Eleventh International Conference on Tangible, Embedded, and Embodied Interaction*, 47–56. https://doi.org/10.1145/3024969.3025007

van Dijk, J., & Oral, L. (2025). In support of neurodiverse participatory sensemaking. *Language Sciences, 110,* 101717. [part of article collection]

Varela, F., Thompson, E., & Rosch, E. (1991). *The Embodied Mind: Cognitive Science and Human Experience*. MIT Press.

Victor, B. (2014, October). *The Humane Representation of Thought*. https://vimeo.com/115154289

Victor, B., Chiacchieri, G., Schachman, T., Gingold, C., Ochshorn, R., Nagle, M., Te, P., Horowitz, J., McArthur, V., Iannini, L., Hsu, W., & Rizwan, O. (2024). *Dynamicland*. https://web.archive.org/web/20241003003058/https://dynamicland.org/

Wilson, D., & Sperber, D. (2004). Relevance Theory. In L. R. Horn & G. Ward (Eds.), *The handbook of pragmatics* (pp. 607–632). Blackwell.