Editorial

The cognitive dynamics of distributed language

Until the 1990s cognitive science relied on comparing human cognition to how everyday computers process information. However, with the advent of connectionism, neuroscience and robotics, symbol processing fell out of favour. Physical symbol systems are now rarely seen as appropriate models for brains or minds (MacDorman, 2007). Extending the critique of symbolic models to language, David Spurrett and I linked distributed cognition with integrational linguistics. We organized a conference in Durban where participants addressed questions like “Is intelligent behaviour (and language) based in the dynamical coupling of bodies?” and “Once we reject code models, how can we reconceptualise language and mind?” As respondent, Harris (2004, p. 728) was sceptical about this linking because, he believes, mental activities are best understood in lay terms. Talk of distributed cognition plainly falls foul of “commonsense lay ways of talking about the mind”.

As editor of the special issue of Language Sciences arising from the conference, Spurrett responds to Harris:

Either we think that science can tell us that we’re wrong with how we think things are with us…even to the extent of showing our common sense, or vulgar, self-conception to be deeply mistaken, or common sense is holding some kind of trump so it always beats science, or even that it never has to pay any attention to science (Spurrett, 2004, 497).

Harris regards common sense as setting limits on what can be thought. Like language, mind is shaped by experience and, he implies, is bound to elude science. Those at the Durban meeting, however, took a different view. There all agreed that the concept of distributed cognition led beyond standard views of both codes and communication. Instead of focusing on mental states and linguistic forms, we can focus on coupling between brains, bodies and the world. Rejecting models that trace language to the manipulation of mental representations, Love (2004) concurs that language-activity is grounded in causal processes. This view of first-order language is thus compatible with embodied, embedded cognitive science.1 Pursuing this approach, the Distributed Language Group was formed and,

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1 For Wheeler (2005), this approach is based on four intertwined ideas: online intelligence is primary; this is generated by complex causal interactions in an extended brain–body–environment system; these processes are grounded in biology; they can be modelled by dynamical systems theory.
in September 2005, held its first conference at Sidney Sussex College, Cambridge. I am honoured to have been able to edit the collection of papers which has emerged from that event.

By moving beyond symbolic models of mind and language, the contributors breathe new life into the language sciences. Linguists from formal, bio-cognitive, systemic, and integrational traditions connect with both game theory and computer simulations. In so doing, they fill out philosophical themes associated with labels like extended mind and cognitive integration.\(^2\) Building on the Durban consensus, the call for *Cognitive Dynamics and the Language Sciences* asked contributors to emphasise “how bodies and artefacts impact on cognitive dynamics”. Specifically, they were asked to consider “time-scales that affect communication, development, cultural history and natural selection”. Pursuing debate between Love and Ross, the contributions examine whether languages are, in any sense of the phrase, *digital codes*. Then, they give reason to attribute importance to the dynamics that enable language to connect brain, body, and world. As demonstrated in this collection, the outcome of this work is a remarkable synergy.

The first issue on which contributors concur is that language is distributed. It is “a temporally situated process – the process of making and remaking signs in contextualized episodes of communication” (Love, this issue). Given that language exploits many time-scales, the process cannot be reduced to the functioning of a dedicated neural system that recognises and produces linguistic forms. Rather, during social activity, language activity is tightly constrained by both our sensitivity to circumstances and our skills in using many second-order cultural constructs. Although profoundly shaped by a history of verbal analyses, language is rooted in what Linell (this issue) calls the “other orientation” of dialogical brains. We deftly integrate cultural products that include ‘words’ with finely concerted multimodal expression. The resulting dialogue functions to regulate what each party feels, does, and thinks. This is possible because, while biomechanically based, language invokes discrete categories. Human semiosis is characteristically hybrid in that it unites digital and analogue organization (Love, this issue).\(^3\) This property enables it to instantiate values (Hodges, this issue) by structural coupling (Kravchenko, this issue) that integrates biology, practices, and the use of cultural artifacts (Menary, this issue). Far from being reducible to form, language is heterogeneous, embodied, and spreads across space and time. In spite of its supra-individuality, language relies on human biology to survive. For Kravchenko (this issue), its foundation is the autopoietic principle that states, “one organism produces an orientational influence in another organism”. People enact historically-located language by engaging with each other.

The second point of convergence is that use of a cultural meshwork separates humans from other primates. While chimpanzees co-ordinate by using biomechanics, they lack the cultural practices that anchor human semantics. Perhaps uniquely, we have undergone a phase shift in evolutionary dynamics (Ross, this issue). Instead of relying exclusively on continuous signals arising from the interplay of genotype and phenotype, we use culture to “create our own meaning spaces” (Ross, this issue). Even if some doubt that this depends

\(^2\) The best known philosophical view that treats mental activity as using the world appeals to ‘extended mind’ (Clark and Chalmers, 1998). Others stress that the world beyond the skin complements what the brain does (Sutton, in press) or, in Menary’s (this issue) terms, ‘cognitive integration’.

\(^3\) Since the invention of notations it has been radically heterogeneous. Body-based signalling has been transformed by the use of scripts, documents and other artifacts.
on digital semantics (see below), all concur that historical circumstances impact on how we move, feel, and act. Thus, as described below, debate tends to refocus around the extent to which encultured nature draws on biological (Kravchenko, this issue), as opposed to virtual, organization (Ross, this issue; see Dennett, 1991). Although these contrasts matter (see below), it is significant that both sides emphasise culture. In denying a “mental” origin to first-order language, no one disputes that history has a constitutive role in human imagination.

Rejecting lay (and internalist) views of mind, human signalling prompts us to ascribe reality to second-order objects (e.g. languages, minds, unicorns). Neural activation, social events, and the perceived world give us perspectives. Stressing this third convergence, Ross closed the Cambridge event by pointing out that all were agreed that there were “no such things as linguistic data”. Love puts it differently. Language, he suggests, creates digits “that dwell in the shadow world of the virtual, the indeterminate and the perpetually revisable” (Love, this issue) How can such views be used to ground the language sciences? While Thibault presented micro-investigations of how children integrate meaning-making across modalities (see Thibault, 2005), his paper has (sadly) not seen the light of day. Below, therefore, methods are illustrated by work on the evolutionary emergence of signals. As Cangelosi (this issue) shows, even simulations of interactions between artificial agents produce shadowy properties. Signals emerge in coupling “embodiment factors, internal representation properties and social factors”. This finding points to a fourth convergence. If learning to talk uses cultural ecology, language arises as co-action sets off both individual and social learning. First-order language is behaviour. For this reason, the distributed view contrasts with any form-based approach in tracing language to activity by co-acting bodies.

The perspective can link traditions. First, using ecological theory, Hodges (this issue) traces language to “efforts after meaning and value”. Creativity neither reflects what is ‘in the mind’ nor form-based functions. Rather, people strive after values. Like a perceptual system, language prompts social activity. As we monitor the results, we may, for example, thwart social moves. Using brains that manage socially sanctioned co-ordination, we create good prospects. Pursuing this, Linell endorses dialogism. In exploring connections with a social world, the key principle is, according to him, other orientation. Although shown in work on interaction, this also resonates with neuroscience. Infant brains permit co-action under real-time control. In aligning to others, we use alterity or other people’s perspectives. Neural control also allows us to shift awareness as we talk. This favours what Menary calls cognitive integration or how brains enable us to make skilful use of external resources. Cognitive activity links first-order language with second-order products (e.g. linguistic analyses, texts, documents). Written signs, for Menary, set new bounds for thought. While off-loading cognitive work, we benefit from manipulating physical vehicles. Human cognition exploits slow dynamics where cultural processes impact on phenotypes and, perhaps, lead to changes in the genotype. Because we are partially constituted ecologically, vocal resources and writing can be used to integrate activities in time. We use neural rapidity, intermediate creative action, and wilful use of artifacts (e.g. notations, books and computers).

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4 Bråten (1998), who was unfortunately unable to attend the conference, shows that brains are designed for alterity. In related work, Trevarthen (1979, 1998), appeals to altercentric systems in the human brain (see also, Cowley, 2006; Thibault, 2005).
Since language is no longer limited to form-based systems, we cannot appeal to theories or models that abstract language from behaviour.\(^5\) Hence, Menary, Kravchenko, Love, and Carr all link analysis to social and behavioural research. Other contributors take different approaches. Linell shows parallels between principles of micro-investigations and neuroscience, Hodges critiques the experimental tradition, and Ross uses game theory to rethink what makes humans special. Simulations, however, seem to be an especially powerful tool. As described by Cangelosi (this issue), computational and robotic models can throw light on language evolution. Remarkably, even toy systems require language to be both internally and externally grounded. Thus, for example, simulated verb-like and noun-like signals correlate with how sensorimotor and sensory activity fall under the control of different parts of a network (Cangelosi and Harnad, 2000; Cangelosi and Parisi, 2004). In artificial agents, grounded signals are integral to the processes that shape action. Cangelosi, therefore, both endorses the distributed view and proposes its application to evolving artifacts (and writing systems). By ceasing to idealise what Ross (this issue) calls “a single form of representation structure”, we become able to ask how action, language, and history are connected. Indeed, by tracing the grounding of language to perception of co-action, we may find a path towards conversations with robots.

All contributors reject symbol-processing.\(^6\) In considering what will replace symbols, however, they ascribe varying importance to their biophysical and virtual counterparts. From Kravchenko’s (this issue) biocognitive perspective, language is a “dynamic semiotic dimension of cognition”. In autopoietic terms, structural coupling gives rise to a consensual domain. Unlike e.g. Morse code, language is based on its capacity to trigger connotations. Thus the dynamic system or organism uses structural matching that links phenomenal experience to an environment. Language enables neural systems to self-organize in ways that make the world familiar. Since language is a form of signalling, there is no reason to posit that neuronal activity co-varies with word-forms.\(^7\) Rather, brains help us with how to go on or, in adjusting to conversational moves. Kravchenko thus presents an alternative to the ‘pure abstractions’ of symbols. While autopoiesis sketches how language can build on biophysics, this view too has its limits. It seems unlikely, above all, to explain the individual ability to create meaning (let alone the putative evolutionary phase shift). For Carr, among others, appeal to biophysical processes needs to be supplemented by developmental theory. Emphasising brains, he thinks that these have powers that give us digital signalling. This emerges as babies come to master “social practices including conventions for physical representation of conceptual content” (Carr, this issue) In social life, “immersion in cultural practices” gives babies phonological systems that link “concepts acquired through experience” (Carr, this issue). While language spreads beyond the body, conventions enable us to derive categories from physical signals. Playing down action, Carr stresses the brain’s ability to generalise. In so doing, “dynamic system construction” (Carr, this issue) allows for compromise between the self-organizing and the

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\(^5\) The classic view is, of course, that we can appeal to ‘explanatory adequacy’ (Chomsky, 1965). However, once we deny the homogeneity of language, only synthetic techniques (see Gardenfors, 2000) serve to model how we use signals to connect brains, bodies, and external artifacts.

\(^6\) No one thinks that brains carry out purely syntactic operations on items with determinate formal properties (as in the physical symbol system hypothesis). Most accept that brains exploit the robust tracking that is associated with (non-symbolic) representations.

\(^7\) In autopoiesis, a moment of neural activation is called a ‘representation’.
symbolic. Although brains do not “transmogrify” words (representations in symbolic format), speech connects sounds to externally defined concepts by virtue of a developing system. Strikingly, this is consistent with Cangelosi’s view in that he too posits that signalling promotes a shared lexicon. In playing down the role of virtual patterns, both tend to concur with Tomasello’s (2003) broad approach. To master a language, they believe, it is enough that brains map usage-patterns on to biophysically grounded representations.

Others emphasise – not usage-patterns – but virtual entities. For Love (this issue), words need not be neurally represented, because endless repetition enables us to compress semantic information. Verbal patterns emerge without “antecedent existence”. We need no inner linguistic tokens because, given brain-body coupling, we imagine words. Unlike arithmetic or Morse code, language makes no use of “equivalence mapping”. Verbal units contrast with digits (or dots and dashes) in that they have “no encoding relations to anything outside language”. Although still in need of development, the theme resonates across the collection. First, language is real-time signalling. Second, a wording, e.g. I didn’t leave because I was angry, serves to identify specific thoughts. Linguistic signalling, then, exploits digital patterns that partition the world. What is fundamentally an analogue process of signalling gives us what Ross (this issue) terms an ability to create shared meaning spaces. How is this achieved? According to Carr, conventions enable us to physically represent conceptual content. For Love, repetition leads us to imagine thoughts. For Ross, the origin of digital signalling remains unknown.

Another debate concerns the theoretical role of the digital. While Ross and Love both emphasise virtual patterns their emphasis differs. Their emergence, plainly enough, must depend on function. Thus neither Love nor Ross can follow Carr in appealing to a self-constructed neural system. Instead, drawing on neuroeconomics, Ross doubts that neural change could ever be sufficient to explain use of compressed cultural information. In contrast to how the elephant came to use its trunk or the viper infra-red vision, humans underwent an evolutionary phase shift. We developed selves. Digital signals, Ross (this issue) thinks, emerged together with the ability to construct an agent “similar to a character in a novel”. Love’s (this issue) approach differs. Instead of asking what could use virtual patterns, he focuses on how these are conceptualised or imagined. Emphasising history, he traces our view of the digital to “the communication process”. Alphabetic writing, he argues, prompts the idea of a context-neutral domain of ‘linguistic similarity’. However, appeal to an idea presupposes some kind of ‘self’. Love’s view, therefore, begs the question of whether (and how) the rise of human communication – hybrid analogue and digital signalling – changed primate cognition. By invoking a capacity to entertain ideas, he too raises the issue of how we come to hold perspectives.

Once we focus on the dynamics of distributed language, the world comes to be seen as an arena of multiple co-ordinations. Cognition fuses with communication. For Carr, brains develop convention-oriented systems. For Love, the fusion favours a human ability to repeat bursts of sound and, in historical time, to imagine languages as codes. For Ross, skills in strategic co-ordination drive us to create virtual models of reality and

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8 In contrast to symbolic models, Cangelosi rejects appeal to any single form of representation structure.
9 There are no arbitrary conventions like those, which, as Love (this issue) explains, make it ‘true’ that 13 + 6 = 73.
10 In written texts, verbal patterns are inscriptions (based on a script); both production and interpretation are analogue events that enable us to ‘cognise language’.
intentional conceptualizations of selves. It is, moreover, beyond dispute that modern humans attribute sensations, emotions, and beliefs to bodies. Whether based in biophysics and/or the use of virtual patterns, first-order language partitions the world. Somehow this form of signalling has changed our bodies, our ecology, and, to an extent, human nature itself.

While all contributors work within a broadly naturalist framework, the papers endorse no specific theory. Rather, they are united by the conviction, first, that signs are not given in advance. Second, all agree that semiotic values are not systematically encoded. In contrast to integralational linguistics (see e.g. Harris, 1998), first-order signalling is to be explored and modelled scientifically. Crucially, this focuses on how verbal patterns come to be integral to bodily and neural activity. We need to know how, acting together, human bodies come to make sense of verbal patterns. Thus, an account of our linguistic capacities seems to demand that be given to how babies become conscious subjects.

Signals link bodies to aspects of the world: we imagine words or, in Kravchenko’s terms, signs are intrinsically phenomenological. We exploit cultural-evolutionary cues or what members of our community hear as attitudes, words and meanings. How is this possible? Once again, views differ depending on the weighting we give to the biophysical and the virtual. In line with connectionism, Carr (this issue) views brains as managing “dynamic system construction”. Although based in culture, the pattern-recognising brain comes to represent forms and conventions. Strikingly, Carr’s enduring inner systems parallel Menary’s written marks. As we move away from emphasis on biophysics, weight falls increasingly on process and bodies. Thus, Carr’s appeal to system is more static than Menary’s manipulation. For Linell, dialogue flows, and Kravchenko puts connotations at the heart of language activity. Hodges argues that social constraints trigger value-realising events. Finally, Love and Ross invoke patterns that, like voices (or the concept centre of gravity), compress information. Unlike biophysical entities, these lack a fundamental format. Love thus challenges Carr by stressing the “vagaries and indeterminacies of actual speech events”. At the same time, he doubts Ross’s (this issue) behaviourist view that “stabilities in communication” depend on “objectively measured similarities”. Denying that language reduces to form is one step toward explaining our powers. We need to know when we rely on biophysics and how, if ever, we use virtual patterns to connect circumstances with characteristically indeterminate signals.11

Language operates over the widest possible range of time-scales, from those involved in synaptic firings to those involved in natural selection. While eluding description by a single theory, we can focus on single time-scales. Observations show, for example, that development matters. Although stressed by several contributors, positions again vary across the biophysical-virtual continuum. Carr and Cangelosi concur that language separates and condenses categories by perceptual warping (Cangelosi and Harnad, 2000). Perhaps, phonetic patterns decouple from “dialogical arrays” (Hodges, this issue). Implicitly, as babies master languages their agency changes. Those with radical views assert that a signalling history prompts the rise of a conscious subject. Thus, Hodges stresses wilful creativity and Linell shifts in awareness. Neither, however, asks how language makes us into persons. Finally, at the virtual end of the continuum, Ross suggests that ecology, language,

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11 In principle, these may be different descriptions of the same processes.
and bodies prompt us to spin selves. While Love refuses to be drawn, Ross’s thinking fits both Hodges’ emphasis on how we establish values together and Linell’s concern with how we use dialogue to negotiate identity. It also resonates with treating signs as phenomenal entities that “possess physical structure at every single moment of their existence” (Kravchenko, this issue). Even while stressing conventions, Carr and Menary regard ‘shared’ understanding as incompatible with embodied communication and cognition. The emergence, functions and power of distributed language depend on a history of socially informed action and perception.

How can we build on the synergy of these theories? In my personal view, there are two requirements. First, we need evaluation criteria to test emerging claims. Second, we need models of how digitally charged linguistic signals become integral to biomechanical and neural activity. Although specific phonetic, phonological, semantic, and pragmatic features may use different logic, where features are not physically represented, we need models of how virtual constraints operate. Here, the study of cognitive dynamics demands computational and robotic simulation. In a similar spirit, Hodges suggests that the synergy will enable us to make links with gauge theory. Even if there are no common regularities to dynamics in different time-scales, its metaphors suggest that, like particle identity, human individuals “may be realized only within interactions and within the symmetries that reflect the dynamics of the ecosystem as a whole” (Hodges, this issue). Finally, this resonates with Love’s (2004) claim that studying first-order language aligns “with what distributed cognitionists tell us about mind and its interaction with body and world”.

By rejecting ‘instantiation’, we place the study of language beyond texts, utterances, and discourse. Specifically, we ask how artifacts are integrated with practices and how this changes both language activity and its agents. We can, if we wish, follow Menary by calling this cognitive integration.12 Language occurs without digital codes. Paradoxically, however, we experience it as digital. Furthermore, using signals to partition the world is essential to human life. Love’s cluster of questions thus take on new resonances. How are we to conceptualise language? How is it cognised? How does the linguistic process facilitate our cognitive powers? On Ross’s radical view, moreover, the questions can be turned round. How do conceptualizations of language influence human cognition? To what extent do cognitive powers (imagination) arise from engagement with language? Indeed, how does culturally compressed information enhance what we do? After all, while we are able to talk about everything under the sun (as Love notes) we also remain philosophically confused and, in everyday life, enjoy endless chatter. Once cognition and communication are seen as one, we see language as part of human ecology. Does it promote a social world that depends on selves? Do strategic signals drive the rise of human consciousness?

In conclusion, let us return to how language is grounded in both brain and world (see Belpaeme and Cowley, 2007). This biomechanical grounding process enables bodies to integrate neural activity with social events that are organized around cultural products. Far from relying on the duality of phenotype and genotype, human evolution appears four-dimensional. While phenotypes arise from genetically controlled protein synthesis, human bodies participate in social activities that are organized around second-order

12 While Clark (1998) thinks this can be explained by the pattern-recognising brain, rehearsal of ‘ideas’ may depend on more than identifying formal patterns; related issues arise in Wheeler’s (2004) discussions of how brains can sustain silent rehearsal.
The act of learning to talk exploits social processes that change how we act and perceive. This connects the work of Carr and Hodges with Thibault’s investigations and Cangelosi’s simulations. Given a need to understand how the biophysical relates to the virtual, grounding is the current focus of the Distributed Language Group. In one future workshop, we will be asking how human infants derive language from action and perception and, in another, how robotics can be used to change our models of language. Grounding thus links language and cognition with the person problem, that is, “How can human bodies construct themselves into persons by attuning to patterns or norms in the social environment?” (MacDorman, 2007). In giving new life to the language sciences, we turn to how social aggregates make history and, indeed, how individuals carry out (free) thinking. Since (distributed) language is irreducible to form, science need not be opposed to lay views. While the said is important, experience is inseparable from bodies and cognitive dynamics. Indeed, careful investigation and simulation of multi-scale linguistic events may open new doors for cognitive science. We begin to ask how linguistic signalling can turn humans into the makers of the verbal and other artifacts that, increasingly, shape the future of the world.

References


13 Jablonka and Lamb (2005) identify four types of inheritance: genetic, epigenetic, behavioural, and symbol-based (in our terms, ones based in 'second-order cultural constructs'). This builds on the extended phenotype (Dawkins, 1986) and niche construction (Odling-Smee et al., 2003) by appealing to symbols that, in our terms, may be conventional and/or virtual.

14 How language is grounded exploits the phenomenology of individual experience will be the theme of the next DLG symposium. In 2007, we will also hold a workshop where, together with engineers, we explore conversations with robots. See, DLG page: <http://www.psych.herts.ac.uk/dlg/index.html>
Kravchenko, A., this issue. Essential properties of language, or why language is not a code. Language Sciences 29, doi:10.1016/j.langsci.2007.01.004.


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