Radboud University

IT IS IN THE SINGING; NOT IN THE SONG

A multidisciplinary approach to language use

Thesis for obtaining a “Master of arts” degree in philosophy

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I hereby declare and assure that I, Inge Wertwijn, have drafted this thesis independently, that no other sources and/or means other than those mentioned have been used and that the passages of which the text content or meaning originates in other works - including electronic media - have been identified and the sources clearly stated.

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Abstract

Language, as a social practice, involves abilities not specific to language, e.g. agency, attention, interaction, perception, memory and inferencing. Philosophical perspectives on language use can be enriched by integrating research with cognitive psychology and philosophy of biology. To show how this may work, I outline three 'rebel' theories: *autopoietic enactivism, cultural evolutionary psychology, and normative inferentialism* against a general background of the evolution of language. These can be combined into one levelled framework if we assume cognition to be *normative* and *embodied*, and to be constructed out of old animal parts. Two central processes impact all levels of the new framework: *normative regulation* and *identity-generation*. Suggestions are made for further research based on *predictive processing*.

1 INTRODUCTION

Philosophy of language is paradoxical; the term seems to denote a major philosophical theory but is devoid of any univocal definition (Godart-Wendling, 2021). The field comprises rivalling approaches that are all still being researched today. Frege (1892) is seen as the founding father, famously distinguishing between *sense* and *reference*. He wanted to clarify language by the rules of logic, giving rise to the analytical tradition centred around meaning and its relation to truth. It was not until mid-20th century that *ordinary language philosophy* emerged, i.e. the idea that 'language is use', culminating in the theory of speech acts (Austin, 1962). Next, philosophy of language split its course in two directions. One was oriented towards logic, involving proper names, indexicals, and possible world semantics. The other was a psychological approach, conceiving of language as dependent on intentions and a theory of mind (Grice, 1975). Contemporary philosophy of language, finally, treats truth and reference not as semantic properties but emphasises the commitment that speakers make when they speak (e.g. Brandom, 1994).

1.1 RESEARCH QUESTION

I assume that any theory of language, whatever its focus, should be able to account for its evolution. Hence I will first consider what issues are pertinent to the evolution of language, see section 2.

Taking inspiration from Chemero (2009, pp. 3–16), I will not try to argue that everybody who ever wrote on philosophy of language is wrong, even though this seems to be common practice. To make progress, it would be productive

to adopt a Lakatos-style research program, i.e. with a core of stable and unifying principles and orbited by auxiliary hypotheses that are preferably empirically testable. To obtain such principles, I propose that a theory of language need not account for general abilities, such as agency, attention, interaction, perception, memory, and inferencing, but should integrate concepts from cognitive psychology and philosophy of biology. I follow Craver's definition of 'levels of organisation': parts that are made into higher-level components by being organised spatially, temporally, and actively into 'something' (2015, p. 17); see section 3.

To illustrate how this may work, I will outline three theories and compare how each stands on the issues pertinent to the evolution of language. The three theories are: *autopoietic enactivism, cultural evolutionary psychology,* and *normative inferentialism.* Each of these theories has bones to pick with the traditional views on cognition, language, and their evolution, which is perhaps why they initially caught my attention. Yet I particularly picked them for two reasons. First, these theories endorse or at least are not inconsistent with the view that language is about use; about the singing, not about the song. Second, the foe of their foes turns out to be a common friend: embodiment; see section 4.

1.2 Structure

After this introduction, four more sections follow. In the second section, I give a bird's-eye view of the evolution of language, revealing the terrain to be partially charted, partially wilderness. Paleoanthropological evidence has thrown new light on how old language is. It now seems likely that humans before Homo sapiens already had some form of language. Other questions are more philosophical and deal with what language is, and why and how we came to have it, and to what extent our language abilities are built on or reusing older animals parts.

In the third section, three 'rebel' theories are explored which go against long-held philosophical opinion: *autopoietic enactivism* (Di Paolo), *cultural evolutionary psychology* (Heyes) and *normative inferentialism* (Brandom) against representationalism. Each theory has its own answers to the questions about the evolution of language raised earlier. These are summarised at the end of the section.

Section four describes the result of combining these theories into one framework, i.e. a mechanism with 'levels of organisation'. *Autopoietic enactivism*, as a biological theory of life, agency, and interaction, is the bottom layer. In the middle goes *cultural evolutionary psychology*, accounting for cognitive functions specific to humans. On top goes *normative inferentialism,* which explains the social use of language. The implications of combining these theories are discussed, in terms of the impact on the individual theories and what we stand to gain from the newly integrated framework. In particular, two essential

notions emerge: *regulation* and *identity-generation*. A better understanding of these may be achieved through empirical research, for which the notion of *predictive processing* seems promising.

The fifth section concludes this paper. A glossary is included at the end which explains the hyperlinked keywords associated with individual theories. It is not part of the paper, but is included as a courtesy to the reader. A separate bibliography pertaining only to the glossary, is also included.

2 SURVEYING THE TERRAIN

> A theory of language should account for the evolution of language. However, that landscape is strewn with the ideas of onetime explorers and rivalling theories from several disciplines. I adopt Aristotle's 'elements of circumstance' to take stock.

The origin of language has long fascinated us. Religious texts around the world first posited language as a method of revelation related to its divine origins. Next, scholastic phases in western, Indian, and Chinese thought focussed on the relationship between language and the world (Żywiczyński & Wacewicz, 2019, p. 27). A sudden expansion of the field of anthropology, and the new field of comparative philology, following the discovery that major European languages are related to Sanskrit, created a third wave of interest. With Darwin's evolutionary theory (1859), a fresh way of looking at the origins of language emerged (Hewes, 1977, p. 101). That enterprise was fraught with setbacks from the start. In 1866, not even 10 years after Darwin's publication of the Origin of Species, the Linguistic Society of Paris banned all discussion of the evolution of language. The Philological society of London followed in 1872 (Corballis, 2009). Lack of scientific data was assumed to be the reason, allowing Berwick and Chomsky (2019) to proclaim that since there was no evidence of the evolution of language, it did not happen. However, the ban turned out to be directed against anthropologists and in favour of Catholics: it was a political statement and not in aid of science at all (Dennett, 2017). It is not just the evolution of language attracting opportunism and wishful thinking; the larger topic of evolution seems to have suffered the same fate. Landau (1991) examined key paleoanthropological texts from Darwin onwards, and found them to be structured like the universal hero tale: the humble hero (the non-human primate) going on a dangerous journey, receiving talents, being tested and finally arriving at a higher state (the human).

This century has seen a surge of fresh interest in the evolution of language. Progovac (2019, p. 4) puts Pinker and Bloom (1990)'s paper entitled 'natural language and natural selection' as its starting point. Yet the

evolutionary emergence of language is still considered the "hardest problem in science" (Christiansen & Kirby, 2003). Because language does not fossilise, there is no direct evidence to work with. However, that does not resign us to armchair philosophy. We can create models to create testable predictions, similar to geologists advancing the theory of plate tectonics (Fitch, 2017, pp. 3–4). Fitch also points to the influx of new empirical data, e.g. Paleo-DNA, providing us with new insights, as well as new interdisciplinary research (e.g. the bi-annual EvoLang conference series). Żywiczyński and Wacewicz (2019, pp. 124–126) note the new attention for social factors, the extension of biological research toward other species and the accumulation of word-wide big data compiled through linguistic studies.

Despite the evolution of language having become a more or less respectable area of research, serious controversies remain. Not all are philosophical controversies, but given the emotions surrounding this topic, let's get our bearings first. Taking a leaf from hermeneutics, I will use Aristotle's elements of circumstance in its modern form (5 Ws + H) and categorise current controversies using who, what, when, where, why and how questions (Aristotle, 350 BC as cited in Sloan, 2010, p. 239).

2.1 WHAT IS LANGUAGE?

A social code externally shared? A cognitive system? A biological faculty? Botha (2000, pp. 151–152) noted thirteen different conceptions of language at the first EvoLang conference in 1996. One reason for this is that philosophy of linguistics and philosophy of language have rather different interests. According to the Stanford Encyclopedia, philosophy of linguistics is "philosophy of science as applied to linguistics", and contrasts "sharply from the philosophy of language, traditionally concerned with matters of meaning and reference" (Scholz et al., 2020). Indeed, for decades the dominant philosophical view of language was *representational*. Simply put, we assign names to objects, and predicates to sets of objects. Having so created representations of our knowledge of the outside world, we can then use these in our mental reasoning, and from there, to language. This way of looking at language is the subject of a heated exchange between Mark Johnson and Hans Glock. Johnson (2018) claims philosophy of language equals analytical philosophy equals a *disembodied view of language*. As it is the body which is the carrier of evolution, it is no surprise language philosophers have not been interested in it. Glock (2018) points out that in pragmatist circles, language is regarded as an intersubjective practice, and that some of its members, like Wittgenstein and Strawson, have actively explored embodiment. To Glock, the lack of interest in embodied practices—including,

he says, from pragmatists like Austin and Brandom[1]—is an oversight rather than proof of incompatibility with philosophy of language.

2.2 WHO HAS LANGUAGE?

Is language unique to Homo sapiens? This is part of a larger question about animal cognition. On one side of the debate, we have the romantics who think animals are like humans; on the other side the killjoys[2] who think human abilities are unique. To illustrate the vehemence of the discussion: Starzak and Gray (2021) recently proposed to end the "animal cognition war" by introducing a 3-way model to plot components of causal cognition across species.

A related issue is whether we should restrict our search for language to chimpanzees, as is the common practice. Lameira and Call (2020) argue that adhering to a single-species model is dangerous, because then we miss out on much evolutionary variation amongst great apes.

2.3 WHEN DID LANGUAGE EMERGE?

The answer is of particular importance to those believing only Homo sapiens have language, giving rise to another fierce debate. Chomsky initially assumed that language emerged around 50.000 years ago (2005, p. 3), which would make language exclusively human. Dediu and Levinson (2013), based on genetic evidence of the descendants of H. heidelbergensis (Homo sapiens, Denisovans and Neanderthals) concluded H. heidelbergensis must have had some form of language, so language must have emerged 400.000 to 500.000 years ago, or perhaps even earlier[3]. This raises the question of how Neanderthal language may have influenced Sapiens language, an idea for which they urge further linguistic research. Unfortunately the genetic evidence, such as the role of the FOXP2 gene, is not conclusive because its role in language development is not clear, and because FOXP2 regulates several hundred genes, including many that appear not to be language-related (Corballis, 2017, pp. 165–169; Diller & Cann, 2011).

This century has already provided us with an influx of empirical data and new techniques enabling us to date archaeological discoveries much more precisely. Eventually, this will give us a full timeline of the evolution of hominids. Likewise we may expect the question whether language, or at least language-readiness, is restricted to Homo sapiens, to be settled by empirical evidence.

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[1] Brandom (2010c, p. 308) says something similar when Dennett queries him on this point: I agree that I have "refused to address an entirely appropriate question" – not only the evolutionary etiological question, but also the engineering question".

[2] Term was coined by Dennett (1983).

[3] Progovac (2019) notes how the idea was at first ridiculed by Berwick et al. (2011) but later papers they allowed for possibility that Neanderthals may have had language; even the date of the emergence of language was quietly pushed back from 50.000 to 200.000 by Berwick and Chomsky (2016)

2.4 WHERE DO WE FIND LANGUAGE?

In the brain? Again, this is part of a larger question about cognition. It long seemed "obviously true" (Keijzer et al., 2013) that our large brain is linked to superior cognitive abilities. It is large: 1355 cc; 2 million years ago the Australopithecus africanus only had a modest 457 cc, which is average chimpanzee-size (Wood & Collard, 1999, as cited in Corballis, 2010, p. 116). A large brain is costly in terms of energy and balance, so there must be a great adaptive advantage to balance this cost. As Dunbar famously noted, there is a correlation between primate brain[4] size and the size of social groups (1993), and between group size and the level of experienced predator risk (Lehmann et al., 2007). Yet the causal connection between brain size and cognition is not so straightforward. A sperm whale has a much larger brain than we do, as does the African elephant, who also has three times more neurons than we do (Rutherford, 2019, p. 30), yet neither speak. Some spiders have brains "no bigger than a poppy seed, yet are capable of remarkably flexible hunting tactics, including the ability to engage in deceptive mimicry, create diversions to distract prey and take long, complex detours to better position themselves for prey capture" (Barrett, 2018). Even creatures without a nervous system, such as bacteria, are capable of cognitive behaviour through chemotaxis (Keijzer et al., 2013).

If language lives in the brain, is it a separate brain module? The dominant view, originally formulated by Tooby and Cosmides, is called *evolutionary psychology*. It conceives of the human mind as built of distinct, Lego-like modules[5], each of them shaped by evolution to solve a particular problem (Neher, 2006). It is sometimes called the 'massive modularity hypothesis' and is related to the classical computational view. This view has come under attack, amongst others by Heyes whose theory is discussed in paragraph 3.2.

And supposing some or all language 'happens' inside the brain, did this brain shape language (Isbilen & Christiansen, 2020) or did language shape the brain (Colagè & d'Errico, 2020)?

Does language originate in the brain and is thence brought forth (like a *song*)? Again, we encounter the so-called disembodied[6] view of language associated with the Anglophone philosophy of language and the computational view of cognition. For decades, this was the received view: "Cognition was computation, and everyone knew what that meant: formal manipulation of quasi-linguistic symbolic representations by syntactic rules" (Beer, 2003, p. 209). Some fifteen years later, Newen et al. (2018, p. 5) put it like this: "The foundation of traditional

[4] More precisely, not brain but neocortex size.

[5] There is considerable philosophical controversy over the notion of *module* which for reasons of space cannot be elaborated on here. see Carruthers, 2006.

[6] Glock (2018) protests that not all analytical philosophers from Frege up until now deny the involvement of the body in language. This is part of the same controversy noted on page 6.

cognitive science used to be the representational and computational model of cognition (RCC). According to this model, cognition is a kind of information processing that consists in the syntactically driven manipulation of representational mental structures… This idea is typically associated with functionalism, which claims that cognitive phenomena are fully determined by their functional role and therefore form an autonomous level of analysis".

Or should we view language as an interactional process involving not just the brain, but also the body and the environment, i.e. without fixed location (like *singing*)? This is what the proponents of 4E cognition say. They believe mental processes are embodied, embedded, enacted and/or extended. As a family of views, 4E cognition denies the traditional way of looking at *cognition*: "Received opinion, particularly with cognitive scientists, has it that cognition resides in the brain. But this idea is confused. It's like saying that flight is inside the wings of a bird. The mind is relational… what's important is not just what is inside the brain but what the brain is inside of—the larger space of the body and culture. That is where we find mind and meaning" (Thompson, 2014). 4E cognition makes the central point that cognition is not confined to the brain, but that the body and/or the environment are involved[7]. Di Paolo et al. (2017, p. 22) provide a useful diagram of the different approaches in contemporary cognitive science, as shown above.

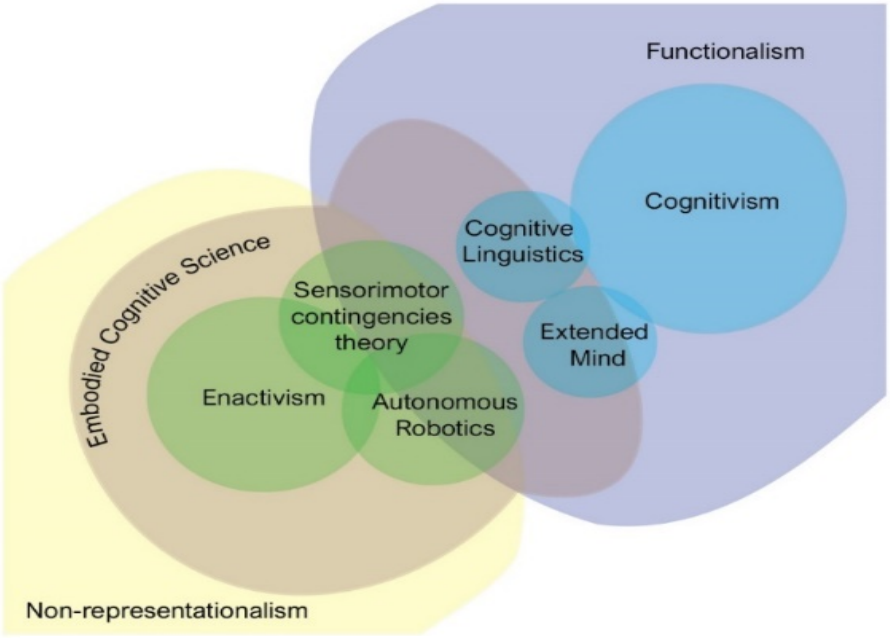

Figure 1 Approaches in contemporary cognition, adapted from Di Paolo et al. (2017).

[7] Beyond that, there are important differences, see glossary entry for 4E cognition.

2.5 WHY DID LANGUAGE EMERGE?

Perhaps for no reason: language happened as a big-bang, through a sudden genetic mutation (Bickerton, 1995 and Crow, 2002, as cited in Corballis, 2010, p. 117). Or is the emergence of language connected to the global shift to a cooler climate, 2.5 million years ago? This is when large parts of Africa lost their woods and became much more open. In such an environment, naked and vulnerable humankind would need a reliable means to coordinate actions with other humans. There is an abundance of hypotheses seeking to explain the connection between the evolution of cognition as an adaptation to deal with ecological or social challenges. Dunbar and Shultz (2017) provide an excellent overview[8]. Social challenges can be cooperative (Vygotskian intelligence hypothesis) or competitive (Machiavellian Intelligence); competitive challenges can be in-group or between groups (González-Forero & Gardner, 2018). Dunbar's own *social brain hypothesis* rests on the idea that living in larger groups increases individual fitness. Since brain size is related to group size, and a large group imposes high cognitive demands, large groups have spurred the development of domain-general cognitive functions which eventually blossomed into language. He further proposed language has first emerged as gossip, a kind of verbal grooming, creating bonds in the larger group, when individual grooming would have been too time-consuming (Lehmann et al., 2007).

The why-question about evolution of language easily slides into the why-question about human behaviour. The received view is *belief-desire psychology,* combined with some form of *mind-reading*—theory-theory, simulation-theory or hybrid: we are rational beings who act according to what we believe and what we want; and we expect other humans to do the same. This view puts intentions and beliefs in the driver's seat. However, its validity is being questioned; therefore, none of the theories examined in the next section depend on it.

2.6 HOW DID THE EVOLUTION OF LANGUAGE HAPPEN?

Many research disciplines have their own take on what the building block of language may be and how to trace them back through the evolution—linguistics, biology, anthropology, neuroscience, psychology. The major controversy is about the speed at which we came into language. Pinker and Bloom (1990) take the *gradual emergence approach* and argue all evolution took place gradually, so why not language? Gradual evolution is a "tinkering" process, where new elements are created by combining older ones, and several solutions may

[8] Because there so many theories, several psychology researchers have attempted to provide criteria for a theory of the origin of language (Szamado and Szathmary, 2006 and Bickerton , 2009, as cited in Laland, 2017, p. 226). Laland (2017, pp. 225–226) himself lists 7 criteria.

be found for similar problems. This idea of "tinkering", e.g. using whatever means at hand to produce whatever is possible, originates with Jacob (1977). It effectively turns evolution into a gigantic Legoland, where old blocks can be made into ever more complex and colourful creations but can as easily be taken apart and reused in yet another configuration. From this "tinkering", mankind might have evolved once, but never again as the palaeontologist Gould (1990, p. 153) puts it: "Replay the tape a million times... and I doubt that anything like Homo sapiens would ever evolve again".

On the other side of the spectrum we find the *saltationists* who claim language appeared suddenly, big-bang style. This is based on the Chomskyan notion of a *universal grammar,* which is necessarily innate. Necessarily, because children learn language without sufficient information about grammar: the poverty-of-the-stimulus argument (Berwick et al., 2011). In the minimal-system version of their theory, Berwick and Chomsky speak of a minimal program: a language phenotype (2016, p. 7) which is transmitted through the genes. This minimal program allows children to learn language from essentially nothing, much like a chicken grows wings, like growing an organ (Chomsky, 1996, p. 7). Progovac (2019, p. 16) says Chomsky has reservations about the validity of evolutionary theory and the role of natural selection. Indeed, Chomsky quotes the paleoanthropologist Tattersall (as cited in Chomsky, 2005, p. 3) as saying that "language is virtually synonymous with symbolic thought" and that he is ''almost sure that it was the invention of language'' that was the ''sudden and emergent'' event responsible for the big leap forward, the rapid trek from Africa. In Chomsky's view, no room exists for "any precursors to language—say a language-like system with only brief sentences. There is no rationale for positing such a system: to go from seven-word sentences to the discrete infinity of human language requires emergence of the same recursive procedure as to go from zero to infinity, and there is of course no direct evidence for such 'protolanguages'" (Berwick & Chomsky, 2016, p. 72).

2.7 TAKING STOCK

Summing up, current paleoanthropological evidence suggests humans before Homo sapiens already had some form of language. This leaves the philosophical questions: what is language, where does it reside, and why and did we come into it? A recurrent controversy is whether the use of language depends solely on brain-bound processing or also involves experiencing the body in its environment. Another controversial topic is the extent to which we share the genetic building blocks underlying our language capacity with animals.

3 THREE 'REBEL' THEORIES

Three 'rebel' theories are selected and explored. Each has its own answers to the questions about the evolution of language that were raised previously. These are summarised at the end of this section.

My proposal (see 1.1) is that a philosophical theory of language need not account for general abilities that not specific to language, but instead should look to integrate concepts from other disciplines. Such an approach allows for a multidisciplinary research program, Lakatos-style, i.e. with a core of stable and unifying principles, whilst allowing for expendable auxiliary hypotheses.

To find such stable and unifying principles, I take a leaf from Craver's of levels of organisation, which he calls a *mechanism* [9], indicating that the whole is more [10] than the sum of its parts: "a mechanism has properties their parts do not have, and they engage in activities that their parts cannot accomplish on their own" (2015, p. 16). He calls those parts 'levels of mechanism', to distinguish them from mereological and aggregational levels. They do things that their individual components cannot. It is this what distinguishes them from purely epistemological levels of explanation. Levels of organisation have *emergent* properties which are more than the sum of its parts, i.e. the whole cannot be reduced to the sum of its parts. This should not scare us. As Craver puts it, if you stack two toothpicks perpendicular to one other, they now have the emergent capacity to act as a lever or a catapult; neither toothpick can do this on its own (2015, p. 20). See the diagram to the right—the explanandum phenomenon is on top.

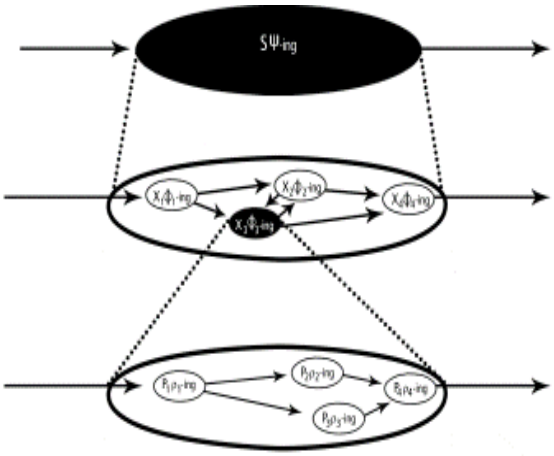

Figure 2 Levels of mechanism, from Craver (2015)

To select theories that might fit together, let's look at requirements first. Craver (2015, p. 3) usefully distinguishes between three defining questions: relata (what is being sorted into levels); relations (why are two items at different levels); and placement or identification (why are two items at the same level). At the top level there is the behaviour ϕ that we wish to explain, in this case language use. At the next level, I posit the cognitive functions that allow this

[9] I will use the more neutral term 'framework', because the debate on mechanisms (Craver & Tabery, 2019) is not my focus here.

[10] This marks the distinction between levels of organisation, such as Craver puts forward, and levels of realisation (e.g. Marr (1982). Levels of organisation are **not** about causal powers. Also see Craver (2019).

behaviour to be expressed. At the bottom, there should be a foundational theory that explains how general biological structure translates into cognitive function. I don't necessarily assume causal relations or aggregations—these relations could exist, but might not. See footnote 10.

Further requirements are that selected theories should endorse—or at least not exclude the possibility that (i) language use is behaviour—singing, not just the song; and (ii) requires cognitive and bodily functions to account for abilities not specific to language, such as agency, interaction, attention, memory and inferencing.

Based on these requirements, I have selected the following theories:

- Top layer, the phenomenon itself: *normative inferentialism*, by Robert Brandom, which is foremost a philosophical theory of language in the pragmatist tradition but also incorporates Brandom's views on thinking.
- Middle layer, what cognitive functions correspond to this phenomenon: *cultural evolutionary psychology*, by Cecilia Heyes, based on both (neuro)cognition and philosophy of mind;
- Bottom foundational layer, what biological structures and processes enable the cognitive layer: *autopoietic enactivism*, by Ezequiel Di Paolo, which is rooted in philosophy of biology;

These theories share another characteristic: they go against long-held philosophical opinion: *autopoietic enactivism* against functionalism and cognitivism; *cultural evolutionary psychology* against gene-based evolution of language and the classical view of modular minds; *normative inferentialism* against representationalism. Each theory is outlined below, starting from the bottom layer upwards, focussing on their answers to current issues in the evolution of language as described in the previous section.

3.1 AUTOPOIETIC ENACTIVISM

Autopoiesis is a biological theory developed by Maturana and Varela (1980) to distinguish living from non-living systems. They defined a living organism as a network of enabling relations able to reproduce itself from its own components and processes. This network is *operationally closed*, i.e. the outside world does not directly take part in its processes or vice versa. Simultaneously, the organism is open to interaction with the outside world, exchanging matter or energy on its own terms.

The enactive version of autopoietic theory was developed by Di Paolo and colleagues and belongs to the 4E family of cognition theories. It is built around the notion of a primordial tension between the organism's interaction

with the environment and isolation behind a safe barrier (Di Paolo et al., 2017, p. 133). *Viability* is defined as the need to keep resolving this tension: the fundamental norm of life, the mother-of-all-values (Weber & Varela, 2002, p. 111). Resolving the tension requires *active homeostasis*, i.e. keeping a 'tab' on running processing through *sense-making* and adjust as necessary. Adjustment may take the form of *adaptation* involving *identity-generation* through *operational closure*. This involves the organism absorbing a pre-existing relationship with the environment in to its *operationally closed* processes, thereby extending its boundaries and changing identity: "To put it bluntly, a non-adaptive being is a soon-to-be-dead being" (Lo Presti, 2020, p. 3).

3.1.1 Where do we find language?

Di Paolo says cognition has no location, but exists in the dynamic interaction between the body, the brain and the physical and social environment. He is vehemently opposed to any kind of embodied functionalism (such as grounded situated cognition) where the body still plays second fiddle (2017, p. 19). Behaviour—interaction, sense-making, adaptivity, agency—is *normative*. It does not require consciousness or self-awareness or intentions, because *viability* is the essential norm of any living creature. Exactly how survival may turn out for a particular organism is determined by the specific configuration of the organism in its environment, resulting in more specific norms as life and evolution progresses. Once an organism can regulate, shape its relations with the environment, mere behaviour turns into agency. When agents engage in interactive behaviour, they become part of each other's sense-making: *participatory sense-making*. During interaction, agents "sustain an autonomous relational domain of coordination" (Cuffari et al., 2015, p. 1099). Once an organism has evolved to the extent that it can remember past interactions, it can create *habits*—both for itself and in its interactions with other agents. The possibilities for interaction become structured by previous interactive experience and available in the joint embodied know-how of the participants. This shared know-how gradually turns into a pragmatics of interacting (Di Paolo et al., 2018, p. 110).

3.1.2 Why did language emerge?

The enactivist proposal for how we came into language depends on the notion of autopoiesis when applied to interaction. Maturana (1988, p. 18) already stipulated language is not about the exchange of information but a form of interaction: "The scientific explanation of language as a biological phenomenon consists in the proposition of a generative mechanism that gives rise to the dynamics of interactions and coordinations of actions that an observer distinguishes as *languaging*". Maturana does not claim language to be a biological phenomenon, merely resulting from the interactions of human beings as living

systems. He does claim that "with languaging observing and the observer arise" (Maturana, 1988, pp. 18–19). So in his view, language is not a system of symbols used to convey information, but an action. Hence the term *languaging*. Like Vygotsky, he believed language shapes and reshapes cognition, in a process of social learning.

Cuffari et al. (2015, p. 1110) build on this notion of *languaging,* explaining it as a special kind of *participatory sense-making*[11] which also serves to build our consciousness and personhood. Importantly, this form of interaction is governed by notions of appropriateness, of rightness—in short, by norms. This is "deeply related to how we make sense of other people and the readiness to interact that underlies human sense-making; which is in turn related to the very public nature of language" (Taylor, 2016 and Brandom, 1998, as cited in Di Paolo et al., 2018, p. 100). The point about enactive interaction, including languaging, is that just as in biological systems, interaction is *autopoietic*: autonomous, self-producing, expanding and meaning-generating through interconnecting, operationally closed processes. Autopoietic interactions are shared between two or more agents, become part of their history and thence take on a life of their own. The diagram below shows the progression of autopoietic interactions, from within a single cell up to humans who have language.

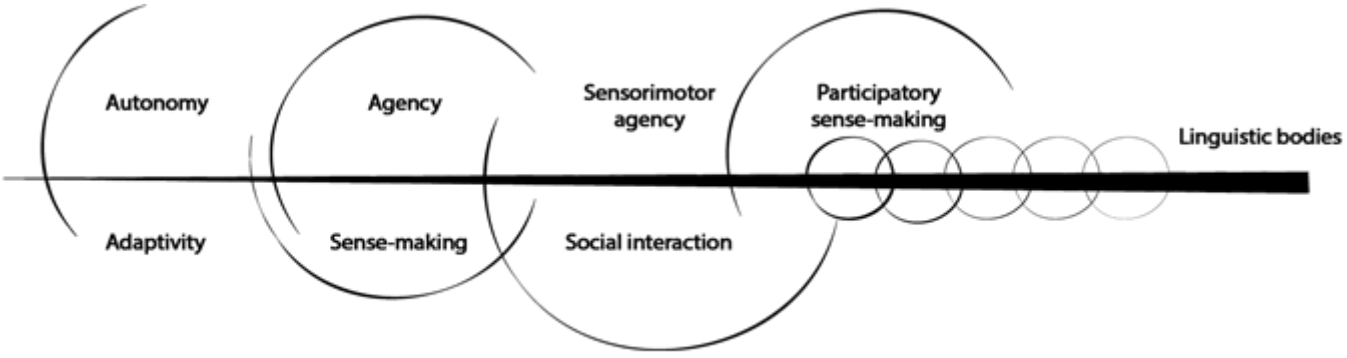

Figure 1 From autonomy to language, after Di Paolo et al. (2018)

Di Paolo et al. (2018, para. 7.4) explain how *languaging*, as a special kind of enactive interaction, may have developed through increasingly complex stages involving different types of social agency. Because they wanted to avoid pre-existing concepts and their pitfalls (Cuffari et al., 2021, p. 118), they used a dialectical[12] model to show how progression from a private to a social and even cultural pragmatics is created out of moving forward through resolving tensions (Di Paolo et al., 2018, para. 6.2). This idea of creating motion out of

[11]Note that this move is not reductionist, i.e. does not assume language to be a subset of interactive behaviour; rather, it is a practical starting point for analysis, for it is assumed that our human use of language is a form of interaction

[12] Specifically, Hegel's dialectics (see Maybee, 2020) but opportunistically used (Di Paolo et al., 2018, para. 7.2)

tension is central to enactive theory as it harks back to active homeostasis as a means of keeping the autopoietic organism alive[13]. It highlights how we experience synergy, as opposed to dissonance, how between individual and interactive normativity: "acts acquire a magic power" (Di Paolo et al., 2018, p. 105). It is the pleasure of feeling in tune. Of walking together, of watching athletes moving in perfect unison with themselves or each other, of singing along with a group. Obviously, this is not specific to language, but Di Paolo et al. may well be right in claiming the existence of a widespread biological drive to experience synchronicity in interaction, as discussed later, in section 4.3.1. Such experiences would be conducive to the further development of language.

Yet this insight does not make *languaging* a theory of language. The theory explains how a practice can become joint between two agents, and how a habitual practice may become shared know-how in a community—but it does not explain why this practice should involve language or indeed what difference exists between linguistic and non-linguistic shared practices. The enactive theory of language halts at the barrier of meaning: "Referring, then, is an emerging outcome of sense-making processes of linguistic bodies becoming together" (Di Paolo et al., 2018, p. 206).

3.2 Cultural evolutionary psychology

Heyes has developed a theory about the origins of distinctively human cognitive abilities. The dominant view on human cognition, *evolutionary psychology*[14], sees the mind as a Swiss Army knife, with separate modules for separate tasks. Heyes regards the mind more like a hand. The hand has a long evolutionary history with many genetic adaptions. But the hand can also perform an open-ended and wide range of technical and social functions that natural selection could not all have foreseen (Heyes, 2012b), from signalling emotions to typing.

3.2.1 What is language?

Heyes uses *language* in several senses: as a behaviour, using words or signs in a structured and conventional way for communication (2018, p. 5); a mechanism specialised for cultural inheritance (2018, p. 87); a skill (2018, p. 186); and as system of communication with certain properties, specifically reference, displacement, syntax and generativity (personal communication, 22 March 2021). She has not developed a specific theory of the evolution of language, but regards it as a cultural *gadget* which children learn through sheer endless examples and feedback.

[13] See the notion of viability earlier in this paragraph.
[14] Heyes refers to it as the "Santa Barbara School" or "high church evolutionary psychology".

3.2.2 When did language emerge?

She endorses the gradualist approach taken by psychologists Christiansen and Chater who claim people did not evolve to learn language but rather "our language abilities emerge through the complex interactions between linguistic experience and multiple constraints deriving from learning and processing" (2016, p. 84). Importantly, through language it is possible to inherit cognitive mechanisms (*mills*, further explained in 3.2.4) culturally: Heyes highlights the example of literacy, which actually reconfigures and creates brain tissue where there was none before (2012a; 2018, pp. 19–22).

3.2.3 Where do we find language?

Heyes regards herself as a 'cognition liberal', i.e. believes a "cognitive process handles information and can be modelled as a form of computation" (Bayne et al., 2019). This is L-cognition, which is not restricted to humans. C-Cognition is the conservative view of cognitive processes involving reasoning operating on propositions, and depending on intentional mental states typically available to conscious awareness. The two views do not mix.

Heyes takes a firm stance on specialised innate brain modules. Although she was ready to accept the prevalent idea of language as innate, she was unable to verify[15] it (Heyes, 2018, p. 196). There is simply no evidence to be found, not for cognition in general, nor for language in particular: "When looking at the neural localization of language, we found it enlists a more widely distributed set of brain areas than any other major psychological function, and that Broca's area is more often active during non-linguistic than linguistic tasks. These data certainly tell against the idea that there is a 'language centre' but it is not clear why it was ever supposed that genetically inherited linguistic information is more likely than culturally inherited information to be implemented in a narrowly localised area of the brain" (Heyes, 2018, p. 195). She says the idea of Chomsky's Universal Grammar was never more than wishful thinking: "We may not need Universal Grammar, but many of us want it. It is wanted by linguists to define their professional boundaries, by evolutionary psychologists as a paradigmatic example of a cognitive instinct, and possibly, at some level, by all of us as a bright line separating humanity from the rest of the animal kingdom" (Heyes, 2018, p. 194).

3.2.4 How did the evolution of language happen?

Heyes' theory distinguishes between *grist* and *mills*. *Grist* are technologies, practices, and ideas; *mills* are cognitive mechanisms. She claims humans do *not* possess any special innate cognitive instincts. Many of our typically human

[15] E.g. the FOXP2 gene, Specific Language Disorder and the poverty-of-the-stimulus argument by Chomsky

cognitive abilities are *gadgets* which are shaped by cultural evolution rather than by genes. We inherit them, but in the way we inherit money, not in the way we get our eye-colour. We are good at social learning. This is enabled by domain-general mechanisms—ancient parts, which we share with other animals. Natural selection has given humans "more powerful general purpose mechanisms of learning and memory, tweaked our temperament and biased our attention so that it is focused on other people from birth" (Heyes, 2018, p. 2). This has put our cognitive abilities into new configurations through social learning, not through genetic variance; like simple bits of technology, arrived at through trial and error. Examples of *cognitive gadgets* include mind-reading, mathematics, mental mapping, language, reasoning—and imitation, in the sense of a cultural inheritance mechanism for communicative and ritualistic actions (Heyes, 2016, 2021). Central to her theory is the notion of *selective social learning*, which has evolved culturally from humble domain-specific beginnings: a high capacity for memory and sequence learning, high-fidelity copying (imitation) which we develop through associative learning, and explicit learning biases such as an inborn preference for faces (Birch & Heyes, 2020). So our minds are not stone-age minds. Our minds have great plasticity: we are learning machines.

3.3 NORMATIVE INFERENTIALISM

For Brandom, to express something is to conceptualise it, to put it in a conceptual form (Brandom, 2009a, p. 16). To say x has knowledge means assigning x a normative social status, involving three things: attributing a *commitment* (a belief taken to be true), attributing *entitlement* to that commitment and *undertaking* that same commitment ourselves (2009a, p. 119). Taking a belief to be true does not require actual truth, but requires belief—Brandom's example is of a parrot being conditioned to say, rather than believing, 'that is red' to red visual stimuli. Assessing x's entitlement to a commitment is a social or interpersonal action, because it involves assessing x's ability to make a true judgement of this kind (Brandom, 2009a, p. 120). This must be done within the context in which the assessment is made and must be inferred from relations between interlocutors, not just from the content of a proposition as logicians normally do (Brandom, 1994, p. 496).

Geurts (2020) has elaborated this notion of shared knowledge into a normative account of *common ground*. To have proposition 'p' as common ground between x and y requires not just x and y having the same information 'p', but also that they both know and accept they have this common ground, i.e. they share a commitment to acting upon it. The point is to be able to distinguish between correct and incorrect actions so we may give and ask for reasons as a social practice. Interestingly, Geurts also shows it is possible for x and y to

share a commitment to 'p' which does not require personal belief. This fits with Brandom's not fully elaborated statement[16] that *objective* community norms and individual norms may contradict, i.e. there is a difference between what is one really committed to and what one is taken to be committed to (1994, p. 253).

3.3.1 What is language?

Brandom says: "I think nothing deserves to be called a 'language' unless some of its performances have the practical significance of claims about how things are—which is to say that some of its expressions must be declarative sentences, they must express propositional contents, and some utterances of them must be assertions" (2010b, p. 301). Brandom insists on assertions being an essential part of language for a reason. He approaches language from two directions: as a social practice (normative pragmatics) and a theory of meaning (inferential semantics) which is based on inferential, rather than truth-conditional relations. We have to understand how a linguistic expression is used, not only by itself but in relation to other expressions, if we are to understand it at all. This is "one of the big ideas that traditional pragmatism brings to philosophical thought about semantics: don't look, to begin with, to the relation between representings and representeds, but look to the nature of the doing, of the process, that institutes that relation" (Brandom, 2008, pp. 177–178). A linguistic expression is a move in a *language game* which—unlike Wittgenstein's language games—is normative: expressing "our notions of authority, responsibility, commitment and entitlement" (Brandom, 2013, p. 369). Brandom effectively replaces semantic assessment of *representations* and their satisfaction of truth conditions as well as the interpretation of intentions by what he calls *deontic score keeping*. "Competent linguistic practitioners keep track of their own and each other's commitments and entitlements" (Brandom, 1994, p. 142): the game of *giving and asking for reasons*[17].

3.3.2 Who has language?

Brandom draws a sharp line between *sentience* (being awake) and *sapience* (being aware), which makes him what Dennett would call a 'killjoy' (Dennett, 1983, p. 346). Non-linguistic animals, such as early hominids, are sentient, but only humans are linguistic, because they are sapient (Brandom, 2009a, p. 157). Only sapient creatures can grasp propositional content, make inferences and reason; indeed "one cannot be a thinker unless one is an interpreter of the speech of others" (Davidson, 1984, as cited in Brandom, 1994, p. 629). Sentient creatures that are not also sapient may take Dennett's intentional stance, but

[16] Brandom makes an appeal to authority, what is common to believe, in chapter 8 of Making It Explicit. Geurts also does not say what "good reasons for believing" might be, just that we "cannot ask Lewis anymore".
[17] Phrase was originally coined by Sellars in 1953, see Salis, 2019

they cannot attribute deontic statuses, and hence cannot play the "social and linguistic game of giving and asking for reasons" (Brandom, 1994, p. 630). Brandom takes this idea even further, to the level of the community to which discursive participants belong. This is in the spirit of Lewis' conventions (1969), but involves more than Lewis' notion of scorekeeping (1979). Lewis' notion relies on presuppositions tracked through mental scoreboards rather than representational contents being understood through their role in attributing and acknowledging commitments (Brandom, 1994, p. 187).

3.3.3 Where do we find language?

Brandom has developed theories on a wide range of subjects, but does not seem to have one on how cognition is related to language or indeed about cognition itself. He says: "it is important to begin by being as clear as possible about exactly what the trick is, when addressing the questions of how the trick is done—how creatures situated, wired up, and trained as we are could come to engage in practices and display abilities that qualify as discursive in this demanding sense—is explicitly put to one side" (Brandom, 2010c, pp. 306–307; also see 1994, p. 155). It is not that he believes such questions cannot be answered—just not by him; which seems to him an "innocuous matter of division of intellectual labor" (2010c, p. 308).

3.3.4 How did the evolution of language happen?

Brandom also wants to say nothing about the evolution of language, beyond "it is clear that there were non-linguistic animals before there were linguistic ones, and the latter did not arise by magic" (1994, p. 155). Through language many things can be achieved, but that does not tell us what language actually is, he says. In a reply to Dennett's "it's pretty, but what is it for?" question, he responds by saying we do not "illuminate the issue of what language is by asking what it is for, what selective advantage it could or did provide our ancestors—though of course, there might be an answer to that question that would be interesting for other reasons" (2010c, p. 307).

3.4 Comparing views on the evolution of language

The brief treatment afforded here to each theory cannot do justice to their breadth and depth. However, from the outline above, we may compare their views on the evolution of language.

		Autopoietic enactivism	Cultural evolutionary psychology	Normative inferentialism
What is	language?	Many things, diffuse and complex	no opinion	At least: propositions
	it that we do when we use language?	Embodied social behaviour	no opinion	Deontic scorekeeping
Who has language?	Non-human primates?	no	no opinion	no
Where in the brain does language happen?	Modular or domain-general cognitive capabilities?	Certainly not modular, but not just brain-bound either.	Domain-general, but much is still unclear.	no opinion
Why did language evolve?		To make sense of other intentional agents.	no opinion	no opinion
How did language evolve?	Big-bang (genetic) or gradually?	Gradually, from animal precursors		no opinion
How does language develop?	Nature (genetic), nurture and/or culture	Nature, nurture, and culture		no opinion

Table 1 Comparing the three theories on their views on the evolution of language

The table shows no contradiction between the three theories. Also, whilst individual theories may not have answers (the blue-tinted entries) to all the questions posed by the evolution of language, collectively they do.

The next step is to combine individual theories into one conceptual framework, so we may have a theory of language supported by a cognitive architecture that can be empirically tested, and a underlying biological theory of cognition.

4 ONE FRAMEWORK

Selected theories are combined into one framework. Gains and consequences are discussed, particularly the now foundational notion, that cognition involves the body and the environment, not just the brain. Two core processes emerge: *normativity* and *identity*. Suggestions are made for further empirical research, based on *predictive processing*.

When combining the three theories into one framework, this is the result:

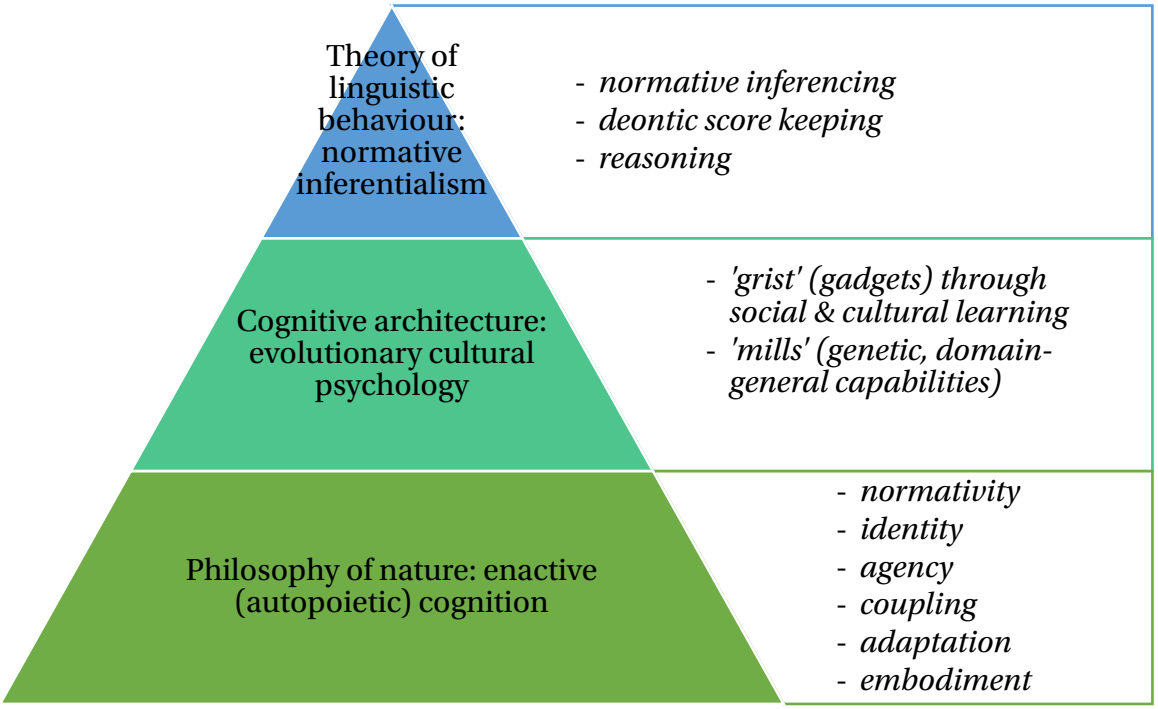

Figure 3 Theories combined into a new framework

This depiction of the new framework is in terms of a layered pyramid, i.e. a loosely coupled and levelled mechanism with interrelations (Craver, 2015, p. 10). The pyramid shape says other types of culturally learned behaviour, such as mind-reading or meta-cognition, might also find a home here. Strictly speaking, the mechanism is three-dimensional, because of the identity-problem described in section 4.3.2: Identity and identity-generation.

4.1 NEW PERSPECTIVES

Combining these theories into one framework provides an additional perspective from which to look at what language is, and hence what is required, in cognitive terms, for felicitous use. The central idea, already quite popular in

certain philosophical circles, is that the basic unit of language is interaction between participants. Language is created in the singing together—the output, the song produced, is not all. Language is social behaviour, even if it is also used for other purposes.

From *autopoietic enactivism* we harvest the idea that every organism, however small, has essential normativity: to stay alive. In order to stay alive, a living system must regulate its internal processes according to pre-determined thresholds and protect them from direct interference from the outside world. It must also interact, build relations with the outside world to get or refresh resources. This dynamic can start off evolution, because it allows the organism to act, to interact and to change. The ability to remember the success or failure of past interaction speeds up the process. This ground pattern is not restricted to biological organisms and their interactions with the environment, such as simple feeding. It also applies to behavioural patterns created between agents, or between groups of agents—say a game of football, which exists as long as the game is being played and then in memory. At a cultural level, successful or popular behaviour patterns may culminate in standard practices—from rearing children to tool-making. Viewed this way, language really is a game—a living game, recreated every moment by its participants, and ever changing and expanding.

From *cultural evolutionary* psychology we learn that the building blocks of cognition are in all living systems—not as specific modules, but as domain-general abilities such as memory and attention. We are special not because our cognitive abilities are special, but because we work our cognitive abilities so hard. This is how, from simple interactions, we have built social, then cultural realities, and keep on expanding further, generation after generation. We have also found out how to extend our basic cognitive abilities by sheer practice: rationality, reasoning, mind-reading, and mathematics, to the extent that we get our bodies to build new brain tissue by learning to read and write. Viewed this way, language—another cultural achievement—might be conceptualised as a many-levelled living system we have long ago started to build. Each level requires a new or improved set of cognitive skills, which in itself allows for new possibilities for expansion. This way of thinking also suggests the possibility of a hard-wired physical upper limit to what our cognitive abilities will allow us to understand about each other through language.

From *normative inferentialism* we learn that we use language primarily to infer social commitments and entitlements for ourselves and for others—to manage our interactions. This applies to one interaction but also to clusters of interactions. As Brandom puts it, to say something is to conceptualise it. To say

many things together with many people is to build shared conceptualisations which will grow and expand over time—as all autopoietic systems do.

We may start to think of language itself in terms of an autopoietic system, or interconnected autopoietic systems, in which we ourselves take part. This provides a social perspective on how we create language to match what is going on our lives. For example, a notion like 'democracy' will not have been part of our language when we first came down from the trees–but the concept of democracy and its implementation must have developed between then and now. It will have taken time to take shape, will have been adjusted countless times until the notion became understandable to a larger group. To put it differently, we must somehow have built the concept together. That process involves more than creating a convention—it implies searching, seeking, finding out together. One can imagine how the 'game of giving and asking for reasons' underpins this process, but also how it takes effort and time, and requires the active participation of everyone in the 'game' to iron out misunderstandings. In modern society, new concepts, ways of expressing, even new speech acts arise as we live and interact- and at ever-increasing speed. Managing the uncertainty that lack of definition inevitably brings with it requires much of our cognitive abilities as a society, and probably also prompts us to invent new coping strategies.

4.2 CONSEQUENCES FOR INDIVIDUAL THEORIES

One important advantage of the layered framework is that it allows for another kind of explanation for what can go wrong in language use, by referring to a lower level. Things can go wrong on the cognitive level, e.g. with memory or attention; or at the biological level, e.g. with the ability to regulate thresholds. The flip side of this is that individual theories must now stick to their own level within the framework, which means:

- for *autopoietic enactivism* to restrict itself to:
  - what Gallagher, following a suggestion by Heyes, has called a holistic "philosophy of nature" (Gallagher, 2017, pp. 22–24), i.e. to inspire and clarify science rather than aim to replace it[18];
  - philosophical treatment of cognitive abilities only when combined with a specific underlying theory of cognition (see languaging, from page 15 onwards, as an example of an approach that is too general).
- for *evolutionary cultural psychology*

[18] Drawing on a distinction by Godfrey-Smith between a scientific research program and a philosophy of nature. Di Paolo et al .(2017, p. 253) themselves regard enactivism as "a non-reductionist yet scientifically engaged philosophy of nature'"

- to investigate specific claims made by both *autopoietic enactivism* and *normative inferentialism,* e.g. the mechanism of active homeostasis in normative evaluations; relationship between self-awareness and normative evaluation; type of inferencing necessary for language use; attribution of agency to non-biological agents, e.g. social groups, habits, institutions; relationship between emotion and synchronised behaviour

❖ for *normative inferentialism* to accept a basis in:

- *evolutionary cultural psychology,* to account for how our abilities to infer, reason and keeping score have developed, both in child development and in evolution;
- *autopoietic enactivism* for general biological processes involving adaptive, interactive and normative behaviour, including the ability to generate new self-organising systems at a biological, sensorimotor and social level, i.e. not claim these processes are specific to language or even to humans.

Combining these three theories into one framework also means accepting that cognition does not happen only 'in the head', but involves both the body and the environment, as 4E cognition proponents claim.

It seems likely Brandom would allow for 4E cognition. Brandom himself outlines a hierarchy of five pragmatic claims, building up from a *sentient* to a *sapient* level. First, sentient creatures direct their intentions towards objects which they deal with skilfully. Next, the most basic form is a Test-Operate-Test-Exit (TOTE) cycle of feedback-governed performance—straight behaviourism. Then the third principle: "Feedback-governed processes, practices and abilities exhibiting this sort of complexity cannot in principle be specified without reference to the changes in the world that are both produced by the system's responses and responded to within each loop in the TOTE cycle. This underlies another important pragmatist claim: *Feedback-governed practices are 'thick', in the sense of essentially involving objects, events, and worldly states of affairs*. Bits of the world are *incorporated* in such practices, in the exercise of such abilities" (Brandom, 2008, pp. 178–179).

Heyes may also be won over. Baggs et al. (2019) note how Heyes' metaphor of grist and mills works well to dispatch the 'instinct' governed idea of cognition, but that the metaphor itself restricts evolutionary cultural psychology to individual, brain-processes. They argue this restriction is unnecessary; modern biological thinking takes the notion of organism-environment mutuality as its evolutionary root; there should be a place for group 'gadgets', not just individual 'gadgets'. Moreover, Heyes herself argues cognitive mills can be the product of human behaviour—literacy being the prime example. Heyes

agrees but expresses disinterest as neither the environment nor non-human cognition is her current focus (2019, pp. 5–6). Yet, she says, ultimately a full explanation of the peculiarities of human lives must integrate research with all four foci: bodies, brain, behaviour, and minds (Heyes, 2018, p. 19).

4.3 CORE NOTIONS

By combining theories in one framework (see Figure 3 on page 16), concepts from philosophy of nature now affect the layers above, i.e. cognitive architecture and theory of linguistic behaviour. It is not a surprise to find *agency, interaction, and adaption* in a biological theory, as these are familiar notions. *Normativity* and *identity,* however, are central specifically to autopoietic enactive theory. What does it mean for a theory of language to be grounded by such notions? It turns out that both notions are more than just static concepts—they involve fundamental processes that have recursive impact on language use.

4.3.1 Regulation and normativity

In *normative inferentialism*, norms belong to "game of giving and asking for reasons". Hence Brandom does not have a theory on the origin of norms: "there is never any final answer as to what is correct; everything, including our assessments of such correctness, is itself a subject for conversation and further assessment, challenge, defense and correction" (1994, p. 647). For Brandom, we humans are normative creatures, as is evidenced from "our notions of authority, responsibility, commitment and entitlement" (2013, p. 369). The uptake of normative significance makes us special. It turns us into the subject of normative attitude and allows us to regard a performance as correct or incorrect (Brandom, 1994, p. 32).

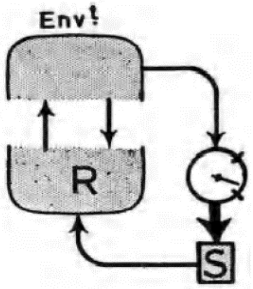

Figure 4 Double feedback loop, from Ashby (1960)

In *autopoietic enactive* theory, the 'mother-of-all-values' (see paragraph 3.1) is survival. The organism must both regulate and self-monitor itself within the bounds set by its internal constitution (*robustness*) and the dangers that come with living (*precariousness*). Di Paolo (2009, p. 15) explains the underlying processes with reference to Ashby's model of adaptive behaviour. To maintain *homeostasis actively*, you need two processes: one which is the primary process, and another one which is monitoring the primary process, to make sure it can keep going (Ashby, 1960, p. 83). Ashby's model has been extraordinarily successful outside his own discipline (psychiatry) and outside philosophy: in modern business life all (inter) national regulations for quality-control are based on the idea of this double feed-back loop. On the physical

level, the act of *active homeostasis* involves a series of processes which take place over time: "It is a structured event, with:

1. clearly defined phases of onset (the sensing of a negative tendency),
2. acceleration (the activation of the adaptive mechanism),
3. consummation (the overturning of the negative tendency) and
4. cadence (the de-activation of the adaptive response).

These phases are reliably, if not invariably, present and distinct" (Di Paolo, 2005, p. 444, my formatting).

According to Brandom, the philosopher is "concerned with reasons as normative, with how we ought to reason, with reasons entitling or obliging us to think some things, more or less independently of what we actually take to be reasons" (2013, pp. 268–269). This fits with his notion that we humans want to be answerable to each other. Yet the philosopher may also be concerned with norms that are not reasons in Brandom's sense. With Di Paolo, we may regard a norm simply as a pre-determined threshold; and regard awareness of this norm as a monitoring system capable of detecting and reacting to unacceptable change. Since this *active homeostasis* is a mechanism fundamental to life itself, we should not be surprised to encounter it everywhere in the living world, including in sapient beings that speak.

A 21st century implementation of *active homeostasis* is to be found in the related notions[19] of *predictive processing (*Clark, 2016*)*, *predictive error minimisation* (Hohwy, 2013), the *free energy principle (*Friston, 2010) and *Bayesian inferential brains* (Jaynes, 1988*)*. Friston describes this move as a "strange inversion" in neuroscience, where the brain changed from being an "extractor of knowledge from sensations" to an "organ of inference, activity constructing explanations" for what is going on out there, beyond its senses (2018). The idea is that the organism and the organismic niche are coupled together "in a process of mutual specification in which the simplest approximations apt to support a history of viable interaction, are the ones that are learnt, selected, and maintained" (Clark, 2015a, p. 7; Clark, 2015b, p. 19). The brain minimises surprises by comparing its representation of the outside world (downstream prediction) against thís outside world (upstream sensory information), to minimise surprise. The notion of *precision weighting* allows for fine tuning of prediction based on *prior knowledge* (Clark, 2015b, p. 5). The words "brain" and "representation", even if these tend to be unwelcome guests in the 4E camp, do not present a threat. Representations emerge in the brain as a means to

[19] Predictive processing originated with Helmholtz in 1867 and focussed on perceptual inference. Its adoption of and application by 4E cognition started only in the last decennium, see Nave et al., 2020. There is a vast amount of recent literature in the wider field of computational neuroscience, theoretical neurobiology, cognitive science and machine learning. For an overview, see for instance Hohwy, 2020.

minimise prediction error, not as an end in themselves, and certainly not as a cause for behaviour in the shape of beliefs or desires. There is no concern with truth or accuracy, but only with "helping the organisms to cope with changing conditions in their external, and internal (somatic), environments" (Shani, 2006, as cited in Clark, 2015b, p. 21)—an echo of Rorty's (1989, as cited in D. Williams, 2018, p. 838) "cognition is for coping, not copying". Friston and Friston (2013) offer a further insight: "The very fact that we can indulge in the same sorts of behaviours repeatedly speaks to the remarkable fact that we are able to maintain a homeostatic exchange with our world—from a physiological to an aesthetic"—which he illustrates with neurological data on birdsong and our ability to enjoy, i.e. predict music.

So, assuming[20] the general mechanism for normative behaviour is *predictive processing,* the enactive interaction between brain, body, and environment has become empirically testable. The question of normativity no longer turns on asking whether normative behaviour is fundamental to our interactions: this is a given. Moreover, when we try to predict each other, we are all using the same process. If we assume survival is to be equated with minimising surprises (Allen & Friston, 2018, p. 2474), the *free energy principle* and *enactive-style autopoiesis* are the same. From this, we may assume predictability to be a norm in itself, which encourages habit forming, as Di Paolo claims. This would explain why turn-taking occurs widely across the animal kingdom: in mammals, birds, insects, and anurans (Pika et al., 2018). It also suggests that speech acts, because of their recognisability, may have come into existence simply to flag a particular type of linguistic behaviour, thus minimising the effort involved in predictive processing.

Interesting questions remain. Social interaction in general, and language behaviour in particular, seems to be about more than staying alive and conserving energy. How and why do other norms emerge? Are all norms equal before *predictive error minimisation*? How, for instance, are conceptual norms processed differently from, say, physical norms? Or are simple norms, perhaps of the kind Andrews (2019) *dubbed naïve normativity* and Heyes allows for (personal communication, 21 August 2020), already present in non-human animals?

4.3.2 Identity and identity-generation

Both Brandom and Heyes treat humans, animals, organisms—as if these are clearly identifiable entities who engage in interaction. Autopoietic enactivism—4E cognition generally—takes a broader view, allowing for the modelling

[20] This view, that predictive coding and enactive cognition may be happily married, is endorsed by a number of philosophers, such as Clark (2013, p. 181), Gallagher (2017, pp. 15–25) and Kirchhoff and Kiverstein (2019, p. 106)

of the interactions themselves as living systems. This has certain advantages, but let's first see how identity emerges.

An autonomous system is defined as a "network of co-dependent, *precarious* processes able to sustain itself and define an *identity* as a self-determined system. The same systemic relation can be found on many different levels. Examples include living cells, immune networks, sensorimotor flows of neural and bodily activity, habits, social institutions and so on" (De Jaegher et al., 2010, p. 442). A system is an *agent* when it can regulate at least some of its structural relations (couplings) with the environment. Because every living system is normative, this means agents[21] are intentional systems.

To generate an *identity* is to possess the property of *operational closure* (Di Paolo, 2009, p. 15), i.e. its operational[22] construction provides its identity as an organism. A well known example is a single cell surrounded by a semi-permeable membrane. It is most easily explained visually, as shown in the diagram (Di Paolo & Thompson, 2014, p. 70). The black circles form part of an *operationally closed* network of *enabling relations.* Each black circle has at least one arrow arriving at it and at least one arrow coming from it respectively originating or ending in another black circle. Dashed arrows show enabling relations between processes in the *operationally closed* network and processes not belonging to it. The *enabling relations* may be complex and extend over time. Examples are blood sugar levels in mammals, deadlines to be kept (how long we can live without water) or continuous-cause influences such as blood circulation (Di Paolo et al., 2018, p. 36, section 2).

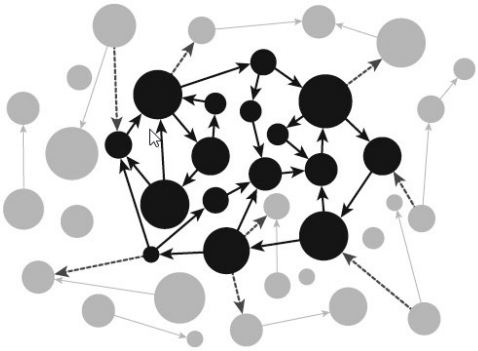

Figure 5 Operational closure, from Di Paolo and Thompson (2014)

Over time, another process (one of the light greys circles, see Figure 5 above) may become part of the operationally closed network. The boundaries of the organism are extended, and a new identity is generated. The important point is that a living system, through its plasticity, may change its identity without meaning to or even being aware of it. This presents a modelling challenge, both on a (new) mechanistic or a (dynamic) network conception, because the

[21] The word *agent* is also often used as a synonym for *sense-maker* and *behaving system* (Di Paolo et al., 2018, p. 342).
[22] The term *operational* highlights that closure is achieved through the actual work and transformations done by processes in time (i.e. not closure in a formal, mathematical sense).

identity of what is being modelled, changes with the new network connections constituting it.

This shifting-identity occurs at all levels of integration with the environment, but at the same time is an essential part of it, because it affords new possibilities to the organism. We already encountered the organic example of the bacterium swimming up a sugar gradient. There is also a sensorimotor (nervous + motor system) dimension, involving loops of action and perception as well as internal autonomous patterns of neural, hormonal, and musculoskeletal activity. At the intersubjective level, we find social interactions, shared between agents, which work the same way, involving each other's operational networks. These may be conversations, shared know-how, a social institution or even a law. As social animals we are part of many autopoietic systems at the same time, and at different levels. Simultaneously, we may be aware of many autopoietic systems which we are not directly part of. This is a real and momentous processing task, is not just a modelling problem. How do we keep track of the biological, sensorimotor and social systems we are connected with, given they are in constant flux? Again, the notion of *predictive processing* may provide the answer. It allows for a kernel architecture based on the monitoring of state-changes, such as a deontic score, rather than keeping track of the processes producing those changes.

As with normativity, interesting questions remain. The need to switch perspectives further adds to our cognitive load. Di Paolo says our ability to stand back and evaluate, crucially separates us from the animals: "Much of what animals resolve by instinct becomes for us an open issue with multiple alternatives. Our choices do not negate 'nature'; they are real choices precisely because we position ourselves at a stage 'before' other determinants make them for us" (Di Paolo et al., 2018, p. 227). But how do we determine what alternative courses of actions exist in a given situation? When and how does (self) awareness play a part? Brandom speaks of a hierarchy of conceptual thinking, each level presupposing mastery of the former: discrimination, rational description, inference, and analytic concept formation (Brandom, 2009b). To Heyes, all conceptual thinking has the status of a cognitive gadget—culturally learned. She points out that although some evidence exists for use of metacognitive learning strategies in non-human animals, cultural learning would require some kind of concept communication, which would presumably require language (Heyes, 2018, p. 266).

Brandom's game of "giving and asking for reasons" encounters a similar issue. One must be able to handle shifts in perspective to keep track of one's own score, the scores of others, of the community; and not only that, but also

keep track of the past[23], present and future of those perspectives. How is this done? Will a theory of agency tell us which agents to pay particular attention to? What happens if—e.g. through lack of cognitive ability—one cannot or no longer can perform these perspective shifts properly or timely? It should be possible to establish empirically whether perspective shifting is involved in deontic scorekeeping, or indeed in any kind of social interaction. In Heyes' terms, perspective shifting may well be a cognitive mill, i.e., a fundament genetic ability with widespread animal precursors, rather than a gadget (grist) such as reasoning, which would depend on—amongst other things—on the ability to shift perspective. Or perhaps, perspective shifting is like literacy—a cognitive *mill* born out of culturally learned behaviour.

4.4 TOWARDS NEW AUXILIARY HYPOTHESES

This section ends with two suggestions for empirical research, to go in the orbit of the suggested Lakatos' style research program. One suggestion is to do with normativity and active homeostasis to watch thresholds. If this is a mechanism present in all living systems, when does this ability become 'cognitive'? What role does attention and (self) awareness play? Is the difference between biological, social and cultural 'scorekeeping' fundamental? The other suggestion relates to our human ability to shift perspective and incorporate perspectives experience before. Is perspective-changing a pre-condition for deontic scorekeeping and hence for language use? If so, to what extent does this apply to other interactions?

Both empirical questions may be approached through the framework of *predictive processing*, because this allows for a cognitive architecture geared towards status tracking.

5 CONCLUSION

Researching the evolution of language would benefit from sharing core notions with cognitive psychology and philosophy of biology. This shifts the burden of proof for an account of general abilities such as agency, attention and interaction, whilst at the same time safeguarding against theorising that is incompatible with empirical research. In order to flesh out this proposal, I have taken Lakatos' idea of a research program, in combination with Craver's levels of organisation and slotted in appropriate theories at the different levels. To illustrate how this may work, I have selected and outlined three theories, described them in terms of their answers to the main issues in the evolution of language,

[23] Brandom (2010a, p. 299) regards a perspective on oneself as social: "if creatures can take up the different perspective to time-slices of themselves, then the relation among those time-slices is social in my sense".

then combined them into one framework. From this, we gain more insight into what language is, and how we humans came to have it:

a) From autopoietic theory we get the notion that normative behaviour and its regulation against pre-determined thresholds is a fundamental characteristic of any living system, as is the need to interact and synchronise. This is not just how biological systems evolve, but also social and cultural ones.
b) From cultural evolutionary psychology we learn that our cognitive abilities are not divine, but constructed out of ancient non-human parts, and have been tweaked by our temperament and our inclination toward synchronised social behaviour.
c) For normative inferentialism we learn how language—propositions specifically—is not about the song, but is about the singing. Singing *together*, that is, for we use language to understand where we stand in relation to others.

Together this triptych of theories suggests our ability for language to be both 'mill' and 'grist'; that shared conceptualisations we create in language together go on to grow and change like living systems, in which we ourselves are participants. This may be how language develops, not just as an achievement fostered by society and coming to fruition in an individual life: that of every child; but also as a living fabric we shape as a society, with old and new parts and parts that are in development as the needs of our society change.

Two core notions emerge from this newly combined framework: *regulation* and *identity-generation*. These turn out to be core processes, rather than static notions and give rise to interesting new questions.

Auxiliary hypotheses may be fruitfully formulated on the basis of *predictive processing*, as this theory ties in well with the notion of regulation and is empirically testable. I have suggested two issues which may be explored in this way: cognitive awareness of norms and perspective-shifting.

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7 GLOSSARY

This glossary defines terms which are specific to the theories discussed here. It is provided as background. A separate bibliography is provided at the end.

<table>
<tr><td>4E cognition</td><td>4E cognition is the view that mental processes are embodied, embedded, enacted and/or extended. The term was coined by Gallagher (Rowlands, 2010, p. 3). Some feel ecology should be added, as 5th E.
<table>
<tr><td></td><td>Cognitive process</td><td>Embedded</td><td>Extended</td><td>Embod-ied</td><td colspan="2">Enacted</td></tr>
<tr><td></td><td>Strength</td><td></td><td></td><td></td><td>Strong</td><td>Weak</td></tr>
<tr><td rowspan="2">Loca-tion</td><td>Bodily = brain-body</td><td>Possible</td><td>included</td><td>possible</td><td>included</td><td>included</td></tr>
<tr><td>Extra-bodily = brain-body-environment</td><td>Possible</td><td>Yes</td><td>possible</td><td>Yes</td><td>yes</td></tr>
<tr><td></td><td>Connected to action</td><td>No</td><td>No</td><td>no</td><td>Yes</td><td>yes</td></tr>
<tr><td rowspan="2">Rela-tion</td><td>Essentially based on (strong)</td><td>No</td><td>Yes</td><td>Yes</td><td>Yes</td><td>no</td></tr>
<tr><td>Causal (weak)</td><td>Yes</td><td>No</td><td>no</td><td>No</td><td>yes</td></tr>
</table>
Table 2 4E cognition varieties, adapted from Newen et al., 2018</td></tr>
<tr><td>5W+H</td><td>See: Aristotle's elements of circumstance</td></tr>
<tr><td>Affordance</td><td>In 1979 the psychologist James Gibson coined the term affordance. Gibson was interested in how animals, such as ourselves, come to attribute meaning during the act of perception. He pitted himself against the prevalent view that animals are complex stimulus-response systems living in a meaningless physical world. For Gibson, meaningful behaviour does not originate in either mental states of physical matter, but in neither or both (Gibson, 1979/2015, p. 129). He has another solution. Animals discover—not create- meaning in the environment. The notion of environment is meaningless without an animal to surround, and likewise an animal cannot survive without an environment (Gibson, 1979/2015, pp. 4, 135). To put it another way, animal, and environment constitute an animal-environment system. Meaningful behaviour is tied to the complementary relation between the animal and its environment (Gibson, 1979/2015, p. 118).
The environment is meaningful to the animal by providing opportunities: affordances, opportunities for behaviour. The environment provides affordances in many ways: substances, surfaces, enclosures, objects, places, events, and other animals. For example: a path affords walking on. A fire affords warmth on a chilly night; it also affords being burned (Gibson, 1979/2015, p. 94). Even information about an affordance is an</td></tr>
</table>

	affordance, because it affords the possibility of use. Gibson describes an affordance as both as a *disposition* and a *relation*: • As a *disposition,* "the affordance is an invariant combination of variables" (Gibson, 1979/2015, p. 126), offering an opportunity for behaviour to the animal. • As a *relation*, the opportunity for behaviour is influenced by the animals capacity to make use of the opportunity. A stone may be used as a missile, a paperweight, a bookend, a hammer or as part of a wall or none of these things. It may mean different things to different animals. Rietveld and Kiverstein (2014) have proposed the *skilled intentionality framework*, which further develops Gibson's notion of *affordances*. Their long-term ambition is "to understand the entire spectrum of skilled human action, including social interaction, creativity, imagination, planning and language use in terms of skilled intentionality" (Rietveld et al., 2018, p. 42). They also connect up *affordances* with the notion of *viability* used by autopoietic enactivism, as a normative concept (Kiverstein, 2016, pp. 330–335) which is endorsed by Di Paolo (Di Paolo et al., 2017, pp. 231, 234).
Agent	Agency allows an organism to act on its own behalf. It is a property, not of the organism itself nor of the environment, but of the variable relation between the organism and the environment. This touches on the same organism-environment relation as the notion of affordances does (Di Paolo et al., 2017, p. 169). The term *agency* refers to the ability of an *autonomous* system to achieve adaptation not only via internal re-organisation, but also by adaptive regulation of its sensorimotor interactions (Froese & Di Paolo, 2011, p. 4). A formal definition: An *agent* is defined as an autonomous system capable of adaptively regulating its coupling with the environment according to the norms established by its own viability conditions. More formally put: A system S is an *agent* engaged in a coupling C with an environment E if and only if: 1. S is an *autonomous* system, meaning that: a. S is an *operationally closed network* of *precarious* processes whereby every process belonging to the network is enabled by at least another process of the network and enables at least one other process in it, so that isolated from the network any component process would tend to run down or extinguish; b. S actively and functionally distinguishes itself as a unity and the set of processes (not belonging to S) that can affect S and are affected by S defines S's environment (E); and 2. S **sometimes** exercises a capacity to modulate the coupling C in an adaptive manner:

	a. where modulation indicates an alteration (dependent on the state of S) in the set of parameters and conditions that affect the coupling between S and E; b. and adaptive means that modulations in the coupling C contribute to keeping S as a *viable* system. (Di Paolo et al., 2017, p. 127, my formatting)
Aristotle's elements of circumstance	"Therefore it is not a pointless endeavour to divide these circumstances by kind and number: (1) the who, (2) the what, (3) around what place or (4) in which time something happens, and sometimes (5) with what, such as an instrument, (6) for the sake of what, such as saving a life, and (7) the how, such as gently or violently" (Aristotle, 350 BC, as cited in Sloan, 2010, p. 239). The modern version (5W+H) was popularised by Kipling (1912): "I keep six honest serving-men (They taught me all I knew). Their names are What and Why and When. And How and Where and Who."
Asymmetric coupling	Organism and environment influence each other a-symmetrically, i.e. the organism regulates the structural coupling (Di Paolo, 2009, p. 15, 2010, p. 50)
Behaviourism	A behaviourist insists on confirming hypotheses about the psychological events in terms of behaviour criteria. There are three kinds: • Methodological behaviourism says psychology should confine itself to studying behaviour, and not concern itself with intern mental states. It is associated with Watson. • Psychological behaviourism is a research method for explaining human and animal behaviour in terms of stimulus, response, and reinforcements. It is associated with Skinner, Watson, and Pavlov. • Analytical or logical behaviourism defines the mind in terms of behaviour. To have a mental state equals having a behaviour disposition. It is associated with Ryle and the later Wittgenstein. See Graham, 2019.
Cognitivism	Cognitivism is a psychological approach to mind and behaviour that emerged in the 1950 as a response to behaviourism. Its definition of cognition is this: "all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used" (Neisser, 1967, p. 4). It claims all mental activity should be modelled as the processing of information using an internal symbol system (see Garnham, 2009 for a historical overview). The term is now used loosely as synonymous with computationalism: "cognitive processes are inferential, computational processes over representations" (Aizawa, 2018, p. 118).
Computationalism	Computationalism builds on representationalism by explaining all psychological states and processes in term of mental

	representations. Cognitive states consist of computational relations to mental representations. Cognitive processes are sequences of such states. So, the brain is a kind of computer, and mental processes are computations (Pitt, 2020, p. 21). It is a mechanistic view, to be distinguished from functionalism, because it makes no claim about the nature of mental states (Piccinini, 2004). The debate between proponents of classical architectures and of connectionist architectures centres on how mental processing works. • The proponents of *classical architectures* believe information is stored as symbols, just as we store data on a computer, en processed through rule-governed programs. Famous implementations of this idea are Fodor's theory of mind and Chomsky's Universal Grammar which fit the mass-modularity view popular with ecological psychologists. • The c*onnectionists* think of the mind as a neural network, where information is stored non-symbolically, in the weights, the connection strength, of the network (Pitt, 2020, pp. 23–24)
Coordination	Coordination is the nonaccidental correlation between the behaviours of two or more systems that are in sustained coupling, or have been coupling in the past, or have been coupling to another, common, system (Di Paolo, 2010, p. 56).
Co-regulation	Some acts are performed together—that is, their enactment requires the organisation of individual sensorimotor coordination patterns into a jointly regulated sensorimotor scheme. Such acts inherently social; those acts, among other things, seek to synergize interactive and individual normativity as part of their own conditions of satisfaction (Di Paolo et al., 2018, para. 7.3.1)
Coupling	In autopoietic enactive theory: when some of its parameters depend on the state of variables in the other (Cuffari et al., 2015, p. 1097). It can be mutual, for instance, a person walking a dog held by a leash (De Jaegher et al., 2010). There are various forms: coordination, co-regulated, structured or symmetrical, asymmetrical, modulated.
Ecology	*Ecology* is seen by some as the missing *E* in what should be 5E-cognition, drawing attention to the similarities between the enactive and the *ecological* approach to mind. The ecological approach was introduced by Gibson in two seminal books (1966 and 1976), and claimed that perception is: • direct (not mediated by representations) • active (it is behaviour **by** the animal, not something that happens **to** the animal)

	• action-orientated (geared toward affordance, i.e. what the environment has to offer to the animal) This looks just like enacted cognition, but unfortunately a historic rift exists between them. According to Baggs and Chemero (2018, pp. 1–2), "Ecological psychologists have traditionally asserted a commitment to realism, while enactivism was initially developed within a constructivist, and therefore anti-realist, framework. Early enactivist writings, indeed, can be more naturally read as advocating a form of idealism rather than realism". They suggest the enactive and ecological approach can and should be aligned. Di Paoli (2017, p. 18, footnote 3) agrees the initial dismissal of ecological psychology by Varela et al. (1991) was "rather quick". Because of this convergence between the two theories, relevant ecological concepts have been added to this glossary, notably affordance, environment, habitat, umwelt and niche, and situatedness.
Embedded cognition	Mental processes have been designed to function only in tandem with a certain environment that lies outside the brain of the subject. In the absence of the right environmental scaffolding, mental processes cannot do what they are supposed to do, or can only do what they are supposed to so less than optimally (Rowlands, 2010, p. 3). *Embedded* cognition makes the same claim as weakly embodied cognition, i.e. being not constituted by but dependent on extra-bodily processes in the environment of the bodily system, see the entry for 4E cognition.
Embodied cognition	Many features of cognition are *embodied* in that they are deeply dependent upon characteristics of the physical body of an agent, such that the agent's beyond-the-brain body plays a significant causal role, or a physically constitutive role, in that agent's cognitive processing within a social world (Wilson & Foglia, 2017, p. 9). *Weakly embodied cognition* makes the same claim as weakly embedded cognition, i.e. being not constituted by but in some weaker way dependent on extra-bodily processes in the environment of the bodily system, see entry on 4E cognition. *Strongly embodied cognition* assumes, with extended en strongly enacted cognition, relations with the body and/or the body-environment to be strong, i.e. constitutive. Embodiment overlaps with the notion of situatedness which is associated with Vygotsky and Gibson.
Enacted cognition	Mental processes are made up not just of neural processes but also of things the organism does more generally—that they are constituted in part by the ways in which an organism acts on the world and the ways in which the world, as a result, acts back on that organism (Rowlands, 2010, p. 3). As McGann et al. put it (2013) "enactivism offers a theory of meaning—a meaning inherent in the complex of relations between a

	cognitive agent and its environment" (2013, p. 207). There are three dominant theories: • *autopoietic or self-organising enactivism*, originally by Maturana & Varela, 1980; extended by Varela et al., 1991 continued by De Jaegher & Di Paolo, 2007; Di Paolo, 2005, 2009, 2010; Di Paolo et al., 2017; Froese & Di Paolo, 2011). This is an all-encompassing approach to cognition. • *sensory motor theory* or *sensorimotor enactivism*, by O'Regan and Noë (2001). The scope is restricted to perceptual experience and is more or less incorporated in *autopoietic or self-organising enactivism* (but see Degenaar and O'Regan (2017) for an analysis of differences). • *REC: radically enacted cognition* (Hutto & Myin, 2013). This approach unifies anti-representationalism rather than presenting a competing theory (Ward et al., 2017, p. 372).
Environment	Environment, habitat, umwelt and niche—this is a cluster of related notions which Gibson could not sort out, as his seminal book was written in the last year of his life. Others have since attempted clarification, as summarised below. Gibson's ecologically inspired view of cognition revolves around the notion of affordance, which depends on the distinction between the meaningless physical world and the meaningful environment surrounding animals. This definition of environment is a little problematic, because it does not allow for the effects of individual experience. Baggs and Chemero (2019, p. 1) offer a "friendly addition", carving up the notion of *environment* into the species *habitat* and animal-specific *umwelt*). In the *habitat*, affordances are potential opportunities (dispositions) for the evolving species. In the *umwelt*, i.e. the surroundings available to a specific exploring and developing animal, affordances are relational. Gibson defined *niche* as a "set of affordances" (Gibson, 1979/2015, p. 120). Not quite the same as a *habitat*, he says, because *niche* refers to how an animal lives, rather than where it lives. Baggs and Chemero (2018, p. 7) point out this "landscape of affordances" (Rietveld & Kiverstein, 2014, p. 346) is dispositional, i.e. possibilities rather than actual relations between the animal and the environment. But there is a difference between affordances generally available to the species, in the form of a *niche*, and affordances available to a specific animal in a specific situation -what Baggs and Chemero (2019) have called an *umwelt).*
Extended cognition	Cognitive systems extend beyond the boundary of the individual organism. On this view, features of an agent's physical, social and cultural environment can do more than distribute cognitive processing: they may well partially constitute that agent's cognitive system (Wilson & Foglia, 2017, pp. 2–3). Since

	its conception by Clark and Chalmers in 1995, alternative versions have been adopted in response to criticism.
Functionalism	The identity of a mental state is determined by its causal relations to sensory stimuli (Levin, 2018). It is to be distinguished from computationalism, because it makes no claim about the way this is done (Piccinini, 2004)
Habitat	See: Environment
Inferential semantics	"The job of semantic theory is to develop a notion of the contents of discursive commitments (and the performances that express them) that combines with the account of the significance of different kinds of speech act to determine a score-keeping kinematics" (Brandom, 1994, p. 142).
Lakatos	Lakatos' MSRP is a radical revision of Popper's falsification criterion, and is regarded as a halfway-house between Popper and Kuhn, who believed in a non-rational theory development. Lakatos says the falsification criterion is far too restrictive—it rules out expert judgments and everyday scientific practise. His idea: a) A *hard core*, devoid of empirical consequences, like the Newton's three laws of mechanics and the law of gravitation and b) A stack of auxiliary hypotheses derived from the *hard core* which can be falsified, e.g. about the position, mass, and velocity of stars and planets (and earth). So, when you get a negative result, you can either change the auxiliary hypothesis or the *hard core*. Normally you would adapt auxiliary hypothesis. This works well as a model for a research programme, because it encourages the development of new understanding through thinking up new auxiliary hypotheses from the *hard core* as a kind of instantiation (Musgrave & Pigden, 2021)
Languaging	Languaging, as Cuffari et al. (2015) use the term as "a form of social agency involving a double regulation of self and interaction that integrates the tensions inherent in dialogical organization and participation genres" (2015, p. 1092). This definition is inspired by Maturana (1988, p. 18), who stipulated that language is not about the exchange of information but a form of interaction: "The scientific explanation of language as a biological phenomenon consists in the proposition of a generative mechanism that gives rise to the dynamics of interactions and coordinations of actions that an observer distinguishes as languaging". Maturana does not claim language is a biological phenomenon, merely that it results from the interactions of human beings as living systems. He does claim that "with *languaging* observing and the observer arise" (Maturana, 1988, pp. 18–19, my emphasis). So in his view, language is not a system of symbols used to convey information, but an action. Hence the term

	languaging. Like Vygotsky, he believed language shapes and reshaping cognition, in a process of social learning. In the Vygotskian tradition, Swain (2006) has popularised the term *languaging*, which she defines as "the process of making meaning and shaping knowledge and experience through language" (2006, p. 97), i.e. to produce language in an attempt to understand—to problem-solve, to make meaning (2006, p. 96).
Modulation	Modulation involves a change in the conditions of the coupling, i.e. alterations in parameters, constraints, and relations between the coupled systems (Cuffari et al., 2015, p. 1097)
Niche	See: Environment
Normative pragmatics	"The significance of a speech act is how it changes what commitments and entitlements one attributes and acknowledges (Brandom, 2009, p. 81)". This turns discursive practices into deontic scorekeeping. "The job of pragmatic theory is to explain the significance of various sorts of speech acts in terms of practical proprieties governing the keeping of deontic score-what moves are appropriate given a certain score, and what difference those moves make to that score" (Brandom, 1994, p. 142).
Pragmatism	Pragmatism is a philosophical tradition which emerged in the US around 1970 as an alternative to analytical and continental philosophy. Broadly, "pragmatists appeal to knowing-how in order to explain knowing-that or, more carefully, saying- or believing-that" (Brandom, 2008, p. 40). There are several varieties, see Brandom (2012, pp. 40–66) for an overview. Brandom himself adheres to what he calls *rationalist pragmatism* "giving pride of place to practices of giving and asking for **reasons**, understanding them as **conferring conceptual content** on performances, expressions and states suitably caught up in those practices" (2009, p. 17, my formatting).
Regulation	Regulation is modulation aimed at satisfying some constraint or norm or achieving some goal. An agent regulates its coupling with the world following the logic of its own constitution as an *autonomous* system (Cuffari et al., 2015, pp. 1097–1098).
Representationalism	A theory of mind claiming mental states (beliefs, desires, perceptions, imaginings) are about things in the external world. They have "intentionality"—*about* or *refer to* things, and may be evaluated in terms of properties like consistency, truth, appropriateness, and accuracy. Mental processes such as thinking, reasoning and imagining are understood as sequences of intentional mental states (Pitt, 2020, pp. 2–3). Shea (2018, p. 6) points out that although the notion of *representations* is widely used, no agreed theory of how *representations* get their contents, exists "We're in the position of the academic in the cartoon musing, 'Well it works in practice, Bob,

<table>
<tr><td></td><td>but I'm not sure it's really gonna work in theory.'" Menary (2010) makes a similar point.</td></tr>
<tr><td>Situatedness</td><td>Situatedness or situated cognition overlaps with the notion of embodiment. Embodiment emphasises the role of an agent's own body in its cognition, while situatedness emphasises the role of an agent's immediate physical and social environment (Beer, 2003, p. 209). The notion of situatedness derives from Vygotsky's work (Costello, 2014). Vygotsky argued there are two different developments giving rise to what we now call cognition: the elementary biological processes and the higher psychological functions which are of sociocultural origin. The history of child behaviour, he says "is born from the interweaving of these two lines" (Vygotsky, 1978, p. 46). The notion of situatedness has also been associated with Gibson, because this fits his theory of affordances so well.
Conceptualisation of situatedness vary with the discipline it is used in. Da Rold (2018, p. 12) identifies two very different meanings for situatedness: grounded and dynamic. Grounded situated cognition is referred to by di Paolo as "embodied functionalism" which depends on body-formatted neural representations where the body still plays second fiddle (Di Paolo et al., 2017, p. 19). Gallagher calls it "body snatching[24]", the body not being essential in a genuine act of cognition (2015, p. 97) but just an aid.
<table>
<tr><td>Situated cognition</td><td>Grounded</td><td>Dynamical</td></tr>
<tr><td>Agent situated in</td><td>Particular social context with accessible perceptual features</td><td>Physical and social environment</td></tr>
<tr><td>Cognition emerges from</td><td>Knowledge and ground concepts, which is structured by the subjective experience of development stability of objective physical properties of the environment unstable contextual information</td><td>real-time, continuous and strictly coupled sensorimotor interaction between an unstable subjective experience and the objective world</td></tr>
<tr><td>Representations exist?</td><td>Maybe</td><td>No</td></tr>
<tr><td>Common ground</td><td colspan="2">Unstable properties of the external and physical world.</td></tr>
</table>
Table 3 Grounded versus dynamical 'situated cognition', after Da Rold (2018)</td></tr>
<tr><td>Structural or symmetrical coupling</td><td>System and environment influence each other symmetrically, i.e. without loss of viability (Di Paolo, 2009, p. 15). It replaces the notion of input-output (Varela et al., 1996, as cited in Di Paolo, 2018, p. 82).</td></tr>
<tr><td>Umwelt</td><td>See: Environment</td></tr>
</table>

[24] Referring to the 1955 science fiction novel.

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