# *The Generative Mind*

## Contents

# Introduction
## *Setting the Stage*

It is well-known that (genuine) theoretical inquiry on aspects of nature can be conducted only on essentially simple systems; complex systems defy principled inquiry. It has been argued that the basic sciences such as physics could reach such depth of explanation because physicists from Galileo onwards held nature to be simple, orderly and thus intelligible; such a view of nature was reached by abstracting away from the complexities of ordinary experience in the phenomenal world. Such abstractions in turn enabled physicists to use elegant mathematical forms for describing aspects of nature hidden from common experience.

Johannes Kepler (1609) held that 'nature is always able to accomplish things through rather simple means, it doesn't act through difficult winding paths.' Galileo Galilei (1632) thought that 'nature generally employs only the least elaborate, the simplest and easiest of means . . . nature is perfect and simple, and creates nothing in vain.' Isaac Newton (1687) suggested that 'we are to admit no more causes to natural things than such as are both true and sufficient to explain their appearances . . . for nature is pleased with simplicity, and affects not the pomp of superfluous causes.' Albert Einstein (1954) said that 'nature is the realization of the simplest conceivable mathematical ideas.' Authors such as Steven Weinberg (1976) in fact trace the *realistic significance* of physics to

its mathematical formulations: ‘we have all been making abstract mathematical models of the universe to which at least the physicists give a higher degree of reality than they accord the ordinary world of sensations’ (1976). Weinberg and others (Chomsky 1980) have called this form of explanation in physics the *Galilean Style*. The style, according to these authors, works as a foundational methodological principle in science, especially physics.

In view of such severe restrictions on the possibility of reaching genuine theoretical understanding, it is not surprising that these restrictions affect scientific pursuits like biology somewhat more directly than physics. Biological systems are not only immensely complex, they are commonly viewed as poor solutions to the design-problems posed by nature. These are, as Noam Chomsky puts it, ‘the best solution that evolution could achieve under existing circumstances, but perhaps a clumsy and messy solution’ (Chomsky 2000a,18). Given the complexity and apparent clumsiness of biological systems, it is difficult to achieve theoretical abstractions beyond systematic description. According to Chomsky, the study even of the ‘lower form lies beyond the reach of theoretical understanding’. As Chomsky (1994) reports in a slightly different context, an entire research group at MIT devoted to the study of nematodes, ‘the stupid little worm’, just a few years ago, could not figure out why the ‘worm does the things it does’. These remarks have an obvious bearing on the biological system at issue,

namely, the mind. ‘Chomsky has argued’, Daniel Dennett complains, ‘that science has limits and, in particular, it stubs its toe on mind’ (1995, 386-7).

In the light of these restrictions on scientific inquiry, the primary goal of this work is to extract and articulate a simple and species-specific notion of human mind from the complexity of cognitive phenomena encountered in the world of ordinary experiences. In effect, the project envisages two broad steps: (a) a principled distinction between human mental phenomena and general cognitive phenomena, and (b) extraction of a simple conception of human mind from the broad human mental phenomena. Such a narrow conception of human mind was mooted in the Cartesian tradition several centuries ago. As we will see, this conception of human mind is no longer widely favoured in philosophy and in the cognitive sciences.

**Overview**

The dominant conception of mind in the philosophy of mind and the cognitive sciences assumes mind to be an assortment of processes and capacities that range from muscle movement and insect navigation to perception, consciousness, language, thinking, etc. In general, researchers use the notion of mind to loosely cover what is taken to be ‘mental’ aspects of organisms, with no further interest in specifying the boundary of the mental. However, the common conception of mind appears to be much narrower and restricted to

humans. When we say that someone has a good mind, we do not mean that the person has acute sense of smell or exemplary attention; we mean that the person displays innovative ways of putting things together, combines ideas in a novel way, throws fresh light on old problems, composes subtle expressions in a language or in music, and so on. In general, the mind is distinguished for its ability to combine representations. Curiously, researchers on cognitive abilities of animals appear to endorse the common view. When arguing for animal minds, they never cite their impressive physical prowess, agility, visual acuity etc. They attempt to give evidence for their ability to count, innovate tools, harbour and express complex thoughts, and the like.

Therefore, in sharp contrast to most philosophers and cognitive scientists, in this work I have proposed and developed the idea that the human mind is *nothing* but a computational principle that combines symbols from a variety of human-specific domains to generate complex structures without limit. In this conception, the human mind *does not* cover familiar cognitive processes such as consciousness, attention, perception, emotions, drives, dreams, and the like. The narrow conception of mind is developed as follows.

In the classical rationalist tradition in philosophy, language was viewed as the ‘mirror of mind’; the view is ascribed to Leibnitz. It was a rather specific conception of mind that was closely tied to the phenomenon of language. In this book, the basic idea is to examine how far the rationalist conception of human mind can be

understood in terms of human-specific capacities such as language and other kindred systems. The idea applies most prominently to the principles of language itself because language is 'one of the few domains of cognitive psychology where there are rather far-reaching results' giving rise to a genuine 'feel of scientific inquiry' (Chomsky 1991). With so much detailed knowledge on human language in hand, it may be possible to examine its mental part with adequate abstraction. So, I basically examine the principles of language to see how the mind looks like. Assuming that language is specific to humans, we cannot look for the mind in this form of inquiry where there is no language or related kindred systems.

Following the proposed inquiry, it appears that, in a delightfully narrow sense, human mind can be identified as the basic structuring principle that constitutes the computational core of language and related systems such as arithmetic and music. Please note that the conclusion concerns human mind itself, not just human language or arithmetic or human music. Human mind is just that, a set of structuring principles, probably a unit set, that lies at the core of these human systems. Call it, *Principle G*, 'G' for 'generative'. So the basic conceptual thesis of this work is that Principle G is the human mind; the human mind is a generative mind. In my view, this part of the work is pretty definitive. I reach this thesis by the end of Chapter Five. The rest of the work is an attempt to give more theoretical shape to the thesis.

In the discipline of biolinguistics, the basic structuring principle

of language is known as Merge. Thus, a prominent line of inquiry in this work is to see if Merge carries the weight of Principle G that constitutes the human mind. We will see that Merge does satisfy some of the major conditions that constitute the rationale for Principle G. For example, it turns out on closer inspection that the operation of Merge is not domain-specific. Furthermore, Merge defines the relevant notion of computation such that the computational conception of mind essentially constitutes of Merge. In that way, viewing Merge as the empirical—perhaps, even the evolutionary—manifestation of Principle G is an attractive theoretical inquiry.

Yet, Merge is after all a product of linguistic inquiry; furthermore, even in linguistic inquiry, Merge is a fairly recent invention (Chomsky 1995a) that continues to attract a variety of alternative formulations (Chomsky 2020). It is not prudent to place the conceptual weight of human mind entirely on the shifting fortunes of a new science. Principle G then is best viewed as an adequacy condition for Merge; in other words, the proposal is to so formulate Merge-like operations in a variety of kindred domains as to meet the conceptual requirement of Principle G. In that sense, the conception of the generative mind in terms of Merge-like operation is work in progress. This part of the work is thus more tentative than the earlier conceptual part.

Keeping to Principle G, I think there is a strong intuition that all there is to the conception of mind is that mind is the source of

unbounded generativity: mind is distinguished in the organic world for its ability to combine cognitive material available elsewhere in nature for humans to put the resulting products to novel use. We can witness this unique feature of the human mind in almost everything humans do: the arts, sciences, religions, music, philosophy, politics, cooking, tailoring, knitting, weaving, inventing games including nearly impossible yoga postures, even innovative sexual practices; only humans have been able to think of the *Kamasutra* and compose the exquisite erotic sculptures in the temples of *Khajuraho*. The examples suggest that, even if human language is the dominant cultural mode for the noted creativity, human generativity extends much beyond the domain of language; in many cases, such as music, cave painting and cooking, it may be meaningless to think of the creativity as a product of human language. That is the idea behind the notion of kindred systems.

Given the large number of human-specific generative abilities just listed, the massive explanatory problem is that we need to reach some evolutionary account of how these abilities came about. Since they were not available in pre-human systems, it is difficult to view them as quantitative modifications of pre-existing functions. Therefore, each of them seems to require *saltational* explanations at some point of their origin: a saltation is a sudden and large mutational change from one generation to the next, potentially causing single-step speciation. Although saltations do occur in nature for emergence of new biological forms such as polyploid

plants, it is an uncomfortable form of explanation for higher-order cognitive abilities, where the required biological explanations are hardly available. The discomfort is enhanced when many saltational steps are needed to account for a large number of cognitive functions of a single species.

In any case, a saltational explanation seems unavoidable for the unbounded generativity of human language. Emergence of Merge appears to require a saltational explanation; there are no half-Merges or demi-Merges in nature. Given the discomfort with saltational explanations, Occam's razor suggests that the entire range of astounding abilities be pinned down to a single saltational principle, if at all. Hence, it is interesting to examine if all human-specific generative principles may have a single Merge-like explanation.

The strict restriction of the concept of mind to humans also suggests a sharp distinction between mind and cognition since there is no doubt that nonhuman organic systems are endowed with a variety of cognitive capacities. Thus, mind is to be distinguished from the rest of the cognitive architecture of organisms consisting of perceptual systems and resulting images, consciousness and subjective awareness, intentionality, representations of distal stimuli, memory, feelings and emotions, depressions, drives, dreams, and the like. The list is obviously incomplete and I am unsure if all of these things coherently fall under the single label 'cognition'; but I am sure that none of them

belong to mind unless there is a strong presence of human language or kindred systems in them.

The distinction between mind and cognition places severe restrictions on the conception of mind. Consider the ‘five aggregates’ doctrine of mind proposed in some versions of Buddhism: material form, feelings, perception, volition, and sensory consciousness. If we grant a bit of volition to an animal, it’ll otherwise satisfy the conditions for a fine Buddhist mind; as we will see, even lowly animals such as nematodes are likely to qualify. According to the narrow conception of mind I am proposing, the Buddhist doctrine is not a doctrine of mind at all; it is at best a doctrine of cognition.

A very similar remark applies to much of what is called philosophy of mind insofar as the primary focus of the discipline is on perception, attention, consciousness, feelings, desires and the like. The study of mind is also disengaged from what may be broadly called the cognitive sciences insofar as these sciences cover cognition as understood above. For now, prior to unification with the rest of human inquiry, the study of mind stands as a separate discipline of its own in active collaboration with biolinguistic inquiry.

In that sense, if I may say so, this work resembles the philosophical and methodological goals of Gilbert Ryle’s influential work on the concept of mind (Ryle 1949), but from an exactly opposite direction. Ryle wished to exonerate the ‘ghost in the

machine' allegedly promoted by the 17th century French philosopher Rene Descartes in his 'official doctrine'. In contrast, I wish to show, among other things, that the first real philosophical and scientific advance on the concept of mind proposed in this book indeed goes back to the classic work of Descartes, as the informed reader might have already detected.

Noam Chomsky has often characterised Cartesian ideas on language and mind as the 'first cognitive revolution'. Chomsky has also characterised the influential developments due to the work of Alan Turing, Gestalt psychologists and others in the 20th century as the 'second cognitive revolution'; Chomsky didn't mention his own ground-breaking work probably out of unwarranted modesty. After acknowledging some of the significant contributions of the second cognitive revolution in our times, this work is compelled to revisit the first cognitive revolution, occurring nearly half a millennium ago, in search of its pedigree.

Specifically, I intend to show that the human mind consists of systems, such as language, music and others, which are paradigmatic examples of what Descartes called *signs*, which are 'the only marks of thoughts hidden and wrapped up in the body.' It is important to emphasize that although we eventually focus on the Cartesian conception of 'signs', the basic goal is to develop a concept of human mind 'hidden' in the body. The human mind is distinguished in the organic world in its ability to entertain thoughts entrenched in a variety of symbol systems. This seems to

be the central message of Cartesian philosophy, notwithstanding its problematic forays into consciousness, innate ideas and divine guidance.

Human language is certainly the most prominent of these symbol systems in which a specific category of symbols, informally called *word*, are woven in an unbounded fashion to generate a variety of linguistic thoughts. Nevertheless, this work argues that the Cartesian message is far more general; there are symbol systems that generate other variety of thoughts such as arithmetical thought, musical thought, artistic thought and the like. Each of them is generative in character and none of them are found outside the species. So, the claim is that all these thoughts are governed by a single generative principle, Principle G. That is the human mind.

**Some key ideas**

In this work, I have attempted to develop a concept of human mind basically by showing that human cognoscitive powers are built upon a core system of principles. In other words, cognoscitive powers such as language, music, arithmetic, kinship relations and other kindred systems share core structuring principles. I am aware of the possible objection that the core system by itself cannot be identified as human mind just because it applies to the domains of, say, language and arithmetic. Some form of 'unity' between language and arithmetic could well be a specific evolutionary consequence; for example, it is sometimes said that

arithmetic is an ‘off-shoot’ of language.

Beyond citing some suggestive cases then, a general conclusion about the (entirety) of human mind requires that we show, via an analysis of the concept of mind, that a coherent conception of mind is restricted exactly to the structuring principle(s) that language, music, and kindred domains share. So we start with the common informal notion of mind and keep tailoring its shape and size to meet the narrow formal requirement enforced by what we have called *Principle G*, the core structuring principle of language.

The task of chipping away from the common thick notion of mentality to reach a thin/narrow notion of mind proved difficult due to the vast extension of the common concept of mind. Commonly, the concept of mind seems to cover not only many aspects of being human, it is often used to characterize almost any cognitive behaviour displayed by (sufficiently) complex organisms. So, even if we may hesitate to apply the concept of mind to cockroaches, apes certainly seem to qualify; topics like ‘Mentality of the Apes’ and ‘Does the Chimpanzee have a Theory of Mind’ raise no eyebrows. As a result, a large variety of directions are currently pursued under the topic of mind; we will review some of them as we proceed.

This is where Cartesianism plays a crucial role. Cartesianism is invoked in this work not merely for some historical support; the basic result about structuring principles could have been stated without recourse to Descartes, as in Mukherji 2010. Descartes is

needed in the project because he did propose a concrete concept of mind. If we are able to align the basic result about structuring principles with the imperishable aspects of Descartes' concept of mind, then the objection raised above regarding the scope of the concept of mind will be partly addressed. Descartes did not ascribe mentality to animals at all because his definition of mentality was narrowly focused on human linguistic ability.

It is methodologically useful to restrict the concept of mind to the species-specific cognoscitive power of language, without denying that wider notions of cognitive abilities could well be extended to other animals to explain some truly intriguing and impressive aspects of animal behaviour. With the amount of cross-species knowledge we currently have, we can now postulate significant cognitive abilities to nonhuman species, the great apes in particular. This range of evidence apparently refutes Descartes' conception of mind *if* his conception is viewed as characterising cognitive abilities in general.

However, a variety of studies show that even well-trained chimpanzees fall short of many abilities that humans routinely acquire: the chimpanzee number sense, social order, gesture system are all finite and essentially stimulus-bound, as we will see. In a very strong sense, therefore, endowment of language makes all the difference between humans and apes. Conceptually, it means that the focused conception of human mind needs to be sharply distinguished from general cognitive abilities in the human case *as*

*well* since humans share a vast repertoire of cognitive abilities with nonhuman animals. With this general perspective on how the inquiry into human mind will proceed in this work, it may be worthwhile to sketch some of the key methodological and conceptual moves that are progressively developed in this work.

*Mind and Cognition*

The complexity of cognitive phenomena is a natural starting point for this work. Even the least developed organisms such as unicellular bacteria are endowed with some forms of sensory system to grasp relevant parts of the world. As we go up the evolutionary ladder, cognitive effects seem to abound everywhere: variety of sharp and acute sensory reactions; complexity of locomotion; identification of food, prey and predator; location of space for shelter; making of nests; storing of food; search for mates; grasping of environmental cues for time of day, season, year; variety of call systems for attracting the attention of conspecifics and for marking territory; rearing of offspring; display of emotions, and the like.

Most organisms show signs of consciousness and some ability for what look like goal-directed behaviour, often appearing to be planned in advance. The phenomenon explodes in diversity and richness when we reach the mammals. We will see many impressive examples of smart behaviour across the animal kingdom. For now, let us suppose that humans share many aspects

of these cognitive effects with other animals, although it is likely that these effects also have human-specific components: nest-building seems to vary widely between humans and birds.

It is plausible to hold that the resources of the so-called basic sciences like physics, chemistry, and even biology, are currently largely inadequate to harness cognitive phenomena just listed. Cognitive phenomena seem to be governed by things like mental images, representations, memory, associations, reflexes, alertness, programming, goal-directedness (intentionality), consciousness, and some degree of voluntariness. It is totally unclear what these things mean in the terms of the basic sciences. Imagine that a specific cluster of neurons fires or a particular chemical reaction occurs when an organism becomes aware of the presence of some familiar predator; we may be able to secure accurate images of such happenings in the brain.

Yet, we have no idea what these images mean, what it means for neurons or chemical reactions to grasp predator information themselves in the absence of the curious human interpreter. Hence, a new form of inquiry—call it *Cognitive Science*—is called for; such an inquiry is new in that it incorporates within its explanatory vocabulary interpretive terms such as *images*, *representations*, *algorithms*, and the like. To emphasize, insofar as *these* cognitive effects are concerned, cognitive science covers both human and nonhuman organisms. However, we need to be cautious when we suggest continuity between human and

nonhuman organisms; there was a substantial evolutionary gap of about 6-7MY between the emergence of humans and the last of the decidedly nonhuman species, the chimpanzees. Even if humans and nonhumans share some cognitive features, they may have some human-specific properties as well, as we will see.

Notwithstanding the range and the depth of cognitive phenomena, it is also pretty obvious that human mental phenomena is markedly distinct from general cognitive phenomena. For example, except for humans, no other animal builds fires and wheels, navigates with maps, and tells stories to other conspecifics, not to mention the human abilities of cave-painting and song-making. Classical philosophers, such as Rene Descartes, postulated mind precisely to mark the glaring distinction between humans and 'beasts'; *prima facie*, it is implausible that the form of explanation for human cognitive phenomena, such as cave-painting, extends to cognitive phenomena such as insect navigation.

Animal models, such as baby mice, are often studied in biology to learn something about the comparable human case regarding, say, the immune system. In a similar way, there are impressive nonhuman models for aspects of human cognition such as perception, attention, consciousness and the like. In contrast, animal cognition, in my view, does not convincingly provide experimentally tractable models for the human case in the domains of language, map-making, tool-making and the like. This is because it is vastly unclear if the terms needed to describe the human cases

apply to nonhuman phenomena at all. In a profoundly strong sense, human mind has no nonhuman model.

Notice the crucial distinction between *cognition* and *mind* already emerging: while nonhuman organisms possess many cognitive capacities, some of which also show up in humans, only humans possess mind. Noam Chomsky observed that, according to some classical philosophers, *men and men alone* were endowed with the noted gifts of nature (Chomsky 1966, 163; Berwick and Chomsky 2016). That was the principle thrust of the Cartesian conception of mind in my opinion. This thrust is not adequately reflected in the popular interest in other Cartesian themes such as consciousness, *cogito ergo sum*, innate ideas, and divine guidance (Yablo 1990; Clarke 2003).

Given the state of understanding almost five centuries ago, Descartes might have pursued these problematic notions to develop his conception of mind 'philosophically'; I will examine the issue in some detail in Chapter Four. With current knowledge on the cognitive abilities of organisms, Descartes' conception of mind as distinctly human can now be fruitfully investigated essentially independently of popular Cartesian themes.

The present concern is that, given the distinction between cognition and mind, the study of mind appears to fall even beyond the scope of the cognitive sciences as envisaged above. Apart from creating a conceptual space for the (specific) study of human mind, the distinction between mind and cognition begins to incorporate

the Galilean constraint on the availability of scientific studies. Once we disengage (human) mind from the vast complexity of cognition of organisms, and try to form a conception of mind in terms of simple and abstract properties of language, the prospect of the study of mind progressively falling within the boundaries of science is enhanced.

*Cognoscitive powers*

I have been frequently mentioning the Cartesian character of the inquiry pursued in this work. So far, I have mentioned two basic Cartesian themes: (a) a principled distinction between human and nonhuman organisms, and (b) an intimate relation between the conceptions of language and mind. The distinction between mind and cognition binds these two themes in categorical terms, so to speak. Humans have both mind and cognition, animals have only cognition; human mind is uniquely constituted of structuring principles of language and related kindred systems. Despite the obviousness and familiarity of the Cartesian postulation of mind for separating humans from nonhumans, my contention is that this specific concept of mind *as distinct from cognition* has not really been studied in the otherwise exploding literature in the cognitive sciences. In fact, as we will see, Descartes himself confused between mind and cognition when he proposed too broad a conception of mind that included consciousness, vision, and language, among other things.

In contemporary times, the Cartesian themes (a) and (b) have generally motivated the Chomskyan linguistic inquiry, as noted; Chomsky initiated the contemporary Cartesian era with his book *Cartesian Linguistics* (1966). However, as we will see, Chomsky's appeal to Cartesian doctrines falls short of the distinction between mind and cognition. Thus, while incorporating some of Chomsky's insights, especially his formal work on human language (see Chapter 6), the specific conception of mind proposed in this work departs in many ways from Chomsky's 'Cartesian' turn in linguistics and philosophy of mind.

In fact, some of Chomsky's thoughts on human mind, especially his idea of the modularity of mind, is directly opposed to what I propose here. As we will see in Chapter Three, Chomsky holds the familiar view that mind is an *array of cognitive domains* such as language, vision, reasoning, etc. However, as far as I know, Chomsky is not exactly fascinated by the study of consciousness as falling under the study of mind (Chomsky 1980) since most mental systems are 'unconscious' in his view. I will not be directly concerned with this notion of unconscious mind in what follows.

In any case, the standard conception of mind held by Chomsky and others views mind as vast, dense and complex; the conception of mind I propose is narrow and simple. The point is, the Cartesian approach to mind I favour is not specifically covered by the otherwise 'Cartesian' conception of language and mind in the Chomskyan tradition. So, as noted, in the original Cartesian

tradition, the concept of mind is commonly viewed as even broader than Chomsky's since it included consciousness as well. In this historical context, our decision to call the novel concept of mind *Cartesian* is a topic that I discuss in Chapter Four in terms of a detailed study of Descartes' writings.

Contrary to the standard 'Cartesian' view then, I will argue that mind consists of a simple operation, Principle G, that is embedded in each of a specific class of *language-like* domains; in other words, although Principle G is the sole structuring mechanism in human language, it is *not* viewed as specific to human language. In theoretical linguistics, the basic mechanism of the computational system of language consists essentially of an operation called *Merge*. However, since Merge is a technical notion, I will keep using the expression *Principle G* informally to denote the single operation until I prepare the theoretical base for Merge in Chapter 6 to explore if Merge satisfies the conceptual conditions required by Principle G. Principle G then is viewed as human mind.

To emphasize, although Principle G was discovered during the study of language, the principle itself is *not* specific to human language, although it is specific to a small (as yet unknown) class of what may be viewed as language-like kindred systems. It is eminently plausible that Principle G emerged much earlier in the hominid line for mind to guide the gradual evolution of human language and the kindred systems. If so, the postulation of mind gives a new direction to the controversies about the origin of

language (Tattersall 2019). I will have more to say on this topic in Chapter Five.

To capture the proposed conceptual scene covering language and kindred systems, I simply adopt the classical notion of *human mind*. I am *not* thinking of human mind as one of the minds in nature, or one of the aspects of some general notion of mind; the concept of mind does not extend even minimally to either God or chimpanzees, not to mention ants and computers. Mind is the outcome of a very special biological design of a species. In that sense, human mind is the only mind; there is no other mind.[i] In my view, the suggested notion of human mind essentially captures Descartes' conception of mind. Hence, I will use *mind* and *human mind* interchangeably.

In contrast, the 'Cartesian' turn in the Chomskyan tradition seems to be restricted specifically to the study of language where language is viewed as a largely preformed, innate system (Chomsky 1972; Chomsky 1986). In my view, the early views of Jerry Fodor on the language of thought also fell in the same genre (Fodor 1975; Fodor 1981). I think there are serious conceptual problems in this form of 'Cartesianism'. The problems arise due to the conflict between the species-specific character of language and the general character of innate systems across organisms. In the Chomskyan tradition, 'Cartesianism' essentially covers the fixed, preformed character of cognitive systems of organisms in line with their biological character. In that sense, *all* aspects of cognition fall

under ‘Cartesianism’; there is nothing specifically Cartesian about language.

In order words, language is ‘Cartesian’ only in that the language system is preformed along with other cognitive/perceptual systems such as the visual system. Language and vision in turn are viewed as components of the mental ‘organ’, in line with the respiratory and the cardiovascular systems. Thus, contrary to Descartes, Chomskyan ‘Cartesianism’ does not distinguish between humans and animals. In an early insightful discussion of the innate basis of various cognitive capacities, Chomsky (1975, 8-10) seamlessly moves from a lucid description of human cognoscitive powers, that impressed rationalists like Ralph Cudworth, to contemporary results on the ‘grammar of vision’ of higher animals, such as the pioneering work of Hubel and Wiesel (1962) on the cat’s visual system. Apparently, all of this falls under ‘Cartesianism’ for Chomsky.

I am not denying that Chomsky is a leading voice arguing for the species specificity of human language; one of his recent books is actually titled *Why Only Us?* (Berwick and Chomsky 2016). Yet, somewhat ironically, the unique species-specific properties of human language do not really have a place in Chomskyan ‘Cartesianism’. Perhaps this is because, according to Chomsky, Descartes didn’t really have anything specific to say on language *per se* (see Chapter Four). So, Chomsky is attracted to Descartes primarily because of Descartes’ internalist perspective on human

cognoscitive powers, a prominent theme in rationalist philosophy. To emphasize, according to Chomsky, the study of language is 'Cartesian' *not* primarily because the linguistic system is unique to the species, but because the linguistic system is innate. It appears that Chomsky's 'Cartesianism' amounts just to the claim that language is a biological system. It is no wonder that something like the distinction between mind and cognition never arose prominently in the Chomskyan framework.

In any case, outside Chomskyan linguistics, strong anti-Cartesianism, even in the domain of language, is the ruling doctrine in contemporary philosophy of mind and cognitive science. According to van Gelder (1997, 446-47), the 'anti-Cartesian movements'—supposedly 'spearheaded' by figures as disparate as Gilbert Ryle in Anglo-American philosophy and Martin Heidegger in continental philosophy—are often viewed as one of the 'greatest achievements of twentieth-century philosophy of mind'. This is because Ryle, Heidegger and others have exposed 'subtle, pervasive and pernicious epistemological and ontological misconceptions inherent in the Cartesian picture'. Anecdotally speaking, I have heard noted sociologists of science and culture trace the bombing of Hiroshima and Nagasaki to the Cartesian 'dualistic mode' of thinking (Mukherji 2000, 9). In this palpably hostile intellectual climate, a formulation of an alternative Cartesian conception of mind is a good reason for writing a book.

Following Descartes and other rationalists, it is natural to trace

the uniqueness of human mind to the endowment of language; rationalist philosophers viewed human language as a ‘mirror of mind’.[ii] By investigating the structure and function of human language, then, we may form a view not only of human language, but of human mind itself as a defining feature of the species. Chomsky (1975, 4) interpreted the rationalist vision as a hope that ‘by studying language we may discover abstract principles that govern its structure and use, principles that are universal by biological necessity and not mere historical accident, that derive from mental characteristics of the species’. As we saw, beyond noting the ‘biological necessity’ of ‘mental characteristics’, Chomsky never really showed what it means to ‘derive’ the ‘abstract principles’ of language from the ‘mental characteristics of the species’.

In this work, I will go much beyond Chomsky’s interpretation of the rationalist tradition. My goal is to examine whether we may use the expression ‘language is mirror of mind’ itself to reach an interesting concept of mind from what we now know about human language. Perhaps the classical intuition was that if mind is to be a substantive notion, it should be possible to detect its imprint in the most prominent of mental systems, language. To reach this more definite perspective on the relation between language and mind, I adopt a literal interpretation of the thesis: to look for mind we have to look into the mirror of language; the mirror of language projects the most prominent view of mind. I suppose the image means that

mind is ‘embedded’ or ‘concealed’ in language such that a conception of mind can be extracted from an examination of the properties of human language. I argue that by studying language we not only discover universal and species-specific principles, we can use some of the core principles of language to *characterize* human mind.

The interest in the topic arose in my mind because the immense literature on cognitive abilities of organisms did not seem to converge on the search for a simple, unified conception of mind specifically restricted to the human case. In particular, very little of the current work on human cognitive abilities touched on the structure of human language; the concern largely holds in the reverse direction as well, as we will see (Chapter Three). There was thus no clear answer to the question: *What kind of mind do humans come to have in terms of their* (*unique*) *possession of the language faculty*?

Rationalist philosophers pointed out that humans are not just passive receivers of external stimuli. Human mind actively contributes from its own inner resources to organize and interpret sensory information. The rationalist philosopher Ralph Cudworth called these resources ‘cognoscitive powers’ which enable mind to raise ‘intelligible ideas and conceptions of things from within itself’ (Cudworth 1731/1996). The ‘intelligible forms by which things are understood or known’, Cudworth held, ‘are not stamps or impressions passively printed upon the soul from without, but ideas

vitally portended or actively exerted from within itself.' For another rationalist philosopher Rene Descartes, the human ability to form conceptions of things from chaotic and often-impoverished experience is akin to grasping of 'a statue of Mercury contained in a rough block of wood' (Cited in Chomsky 1972, 83).

Given the species-specific character of both language and other cognoscitive powers that animated the rationalist discourse, it is natural to think of these things as intimately related. Thus Descartes held that the unique nature of human 'use of signs' is a sure indication of the presence of 'hidden thoughts' that mind generates from its own resources. The idea that the hidden thoughts are *generated* by mind suggests that human language is centrally involved in the construction of these thoughts even before they are articulated. As we will see, several centuries down the line, Charles Darwin also held that 'the continued use and advancement of this power [of speech] would have reacted on mind itself, by enabling and encouraging it to carry on long trains of thought'.

The classical emphasis on species-specific cognoscitive powers continues to be the most plausible picture of how mind is organized. Consider language. In the contemporary literature on language-acquisition, especially in the connectionist framework, it is often suggested that human children acquire the structural aspects of languages by a 'statistical analysis' of the speech-stimuli streaming in from the world. The fact that monkeys, not to mention

kittens, do not pick-up human languages despite prolonged exposure to (human) speech-streams is decisive evidence that they do not have the inner ability (Fitch et al. 2016). This is not to deny that nonhuman species are endowed with general devices for statistical analysis of recurrent stimuli, among other things, for going about in the world, to acquire species-specific call-systems, select mates, locate shelter, and so on. But these nonhuman endowments just do not give rise to language.

In the human case then there has to be at least a weak form of inner ability that somehow couples general statistical resources, if any, with the specificity of speech (Lidz and Gagliardi 2015). But even this weak form seems implausible in the face of evidence that deaf and dumb children acquire sign languages (Goldin-Meadow and Feldman 1979; Gleitman and Newport 1995). In this case there is no speech-stream available to trigger off statistical resources in the first place. Even then these children acquire/invent sophisticated generative procedures essentially out of nowhere. This is not at all surprising since the 'input' to the language-system —the *primary linguistic data*—is itself a product of the faculty of language; unlike, say, the visual system, linguistic data is not 'given' by the world. The most reasonable conjecture is that human children are simply endowed with the required cognoscitive power to acquire languages; the rudimentary primary linguistic data just fine-tunes the capacity, if at all.

From this perspective, we may view the development of rich systems of thought as a natural effect as the language system developed through the advancement of the species. By looking at the structure of human language thus we form a view of what human mind looks like. *In this specific sense*, *the concept of mind genuinely applies only to the human case*. After over half-a-century of exciting work on language, primarily due to Noam Chomsky and colleagues, we now know something of the nature of language. However, it remains unclear what notion of human mind follows from the study of language. Which mind is reflected in the mirror of language?

As formulated, the question is nuanced, especially from the evolutionary point of view. The question appears to demand that we postulate *separate* notions of (human) language and mind while showing that they are crucially related to give rise to a species-specific cognoscitive effect. In other words, although human language and thought systems appear to be distinct cognoscitive powers, the evolutionary effect had been such that one led to the other specifically for the species. Even if we agree that nonhuman species, especially the primates and other advanced mammals, exhibit impressive aspects of thinking and planning through their inner resources, these nonhuman resources are likely to be radically different in character from those of humans due to the absence of language. This requires a marked evolutionary *discontinuity* between human and other species, including our

nearest ancestors. The concept of mind is designed to highlight the suggested discontinuity.

However, if the inquiry is to have initial evolutionary plausibility at the current stage of knowledge, it is prudent to view the suggested discontinuity to have a minimal but critical basis in an otherwise vast body of continuity in the overall architecture of organic evolution. In effect, we look for just the part(s) of these cognoscitive powers, ideally a simple and solitary dynamic principle, that crucially turned the general animal capacities into a specifically human endowment. This is the sense of the focus on the structure of human language to locate the specific form of human mind.

*Narrow mind*

It is worthwhile to emphasise the extremely narrow character of the preceding proposal to distinguish it from apparently similar proposals in the recent literature. By attaching the concept of mind to an abstract structural property of language, I am not really claiming just that mind is ‘algebraic’ (Marcus 2003). Almost any system, when investigated with formal tools, may be described as algebraic in character; for example, insect navigation—not to mention colliding particles—may be understood in terms of algebraic operations. So, the notion of an algebraic system is not specific to human mind. Moreover, although Principal C is a formal operation in that its successive applications explicitly explain the

generation of expressions of mental systems, it is unclear if Principal C is 'algebraic' in character; this is because, at the current state of knowledge, Principal C does not operate on numerical values, it operates on syntactic units of mind. In any case, Marcus' specific attempt to formulate some 'algebra' to describe the massive connectivity inside the human brain is largely irrelevant for the study of mind (see Chapter Three). [iii]

Further, I am not making some general, and nearly tautological, claim about the symbolic character of mind such that humans are viewed as a 'symbolic' species (Deacon 1997). Insofar as humans are linguistic creatures, it is trivially true that they are a symbolic species that somehow connect sign with significance. It appears that by *symbol* Deacon more specifically means some sound or gesture or inscription that somehow refer to items in the world in the favourable cases. It is questionable whether the human use of symbols is referential in character at all, that is, whether the significance of human signs reside in their connections with the world (Chomsky 2000b; Mukherji 2010, Chapter Three; Berwick et al. 2013; Tattersall 2019).

For the sake of argument, suppose human signs are referential in a conventional way. Then, contrary to Deacon, there is nothing specifically human about this ability since nonhuman species also use signs that are unfailingly referential in character: for example, male frogs produce advertisement calls which are signs from the perspective of a predatory bat (Hauser 1996, 9, note 13; Miyagawa

et al. 2018, note 10). Therefore, if Deacon wants the notion of reference to play a species-specific role for human signs, then Deacon needs to come up with an alternative explanation of human reference to explain sound-meaning corelations in human language beyond the trivial claim that there are such corelations.

In any case, the hard theoretical task is to postulate empirically salient principles that explain how the species correlates sound with meaning uniformly across thousands of languages and other symbolic domains while covering virtually an infinity of signed expressions. Deacon's elaborate speculation on how the human brain might have evolved to endow humans with the 'symbol manipulation' ability, without telling us how 'symbol manipulation' operates, does not perform that task. As we will see, the study of the symbolic character of human language has very little to do with the working of the human brain at the current state of inquiry. Principle G, in contrast, is a specific operation that endowed the species with the ability to use a specific form of symbols. We already have this piece of empirical knowledge in terms of the linguistic operation Merge independently of how that ability is executed by the human brain.

Finally, my central claim is not quite that mind is a recursive system (Corballis 2011). I have several problems with this otherwise undoubtedly narrow conception of mind. First, as we will see, the first application of Principle G does not generate a recursive structure, it happens only with the second application, if

at all. Even for the first application, Principle G is (already) a unique endowment of the species in effecting a particular form of sign-meaning corelation. Second, it is not evident that Principle G may be *characterised* as recursive even if it may be so viewed on occasion; *on occasion* because, as we will see in Chapter Six, it is unclear if the language-system is recursive in the sense in which arithmetic is (Arsenijevic´ and Hinzen 2012); in that sense, recursiveness may not be the unifying property of Principle G.

More fundamentally, notions of recursion and computation seem to be a fall-out of Principle G; *we do not have these notions in advance of Principle G*. In other words, Principle G is an empirical discovery concerning human language, and recursion is an abstract idea which makes sense only in the light of Principle G; that is, recursion is a theoretical characterisation, if at all, of what Principle G does. In that sense, the project here is exactly the opposite of Corballis' programme of studying language through the 'lens' of thought, as he claims, rather than exploring human mind through the lens of language as proposed here. This is my basic disagreement with Corballis (2011) who takes the abstract, formally-defined notion of recursion to be a primitive in cognitive explanation.

The reversal of the direction of explanation in Corballis' framework creates formidable empirical and theoretical roadblocks. Since his conception of recursion is independent of language in the sense that human language 'borrowed' recursion

from somewhere else—namely, from the domain of thought—Corballis is committed to argue for the presence of recursion in thought independently of language.[iv] It is totally unclear how an instance of (propositional) thought is to be cited without taking recourse to language. Thought is either structured or unstructured. If thought is unstructured, the question of recursion does not arise. As we will see in Chapter Six, the notion of structured thought without language is deeply problematic. In any case, notice that, in order to clarify what he means by recursion outside of language but restricted to humans, Corballis needs to show as well that nonhumans do not have such recursive thoughts.

To that end, Corballis suggests two tests: mental time travel and theory of mind, both of which according to him require recursive thinking without language; assume so. Thus, according to Corballis, animals do not have a sense of past and future, and they cannot read mind of others. We will see that empirically these claims are not settled at all: some birds can recall dozens of locations where they had stored food in the *past* for *future* consumption, and chimpanzees appear to make intricate inferences about the beliefs of conspecifics (Krupenye et. al 2016). Therefore, Corballis' entire framework collapses if animals turn out to be smarter than he thinks (De Wall 2016). No such problems arise if the operations of mind are viewed with the lens of language. Principle G is what it is, independently of whether it should be called *recursive* or not.

i However, I will leave it open whether there were other hominid species, now extinct, who also possessed mind without possessing the developed form of human language (see Chapter Five). The issue is partly verbal in how we define *human mind* and which stage or aspect of language should be included in that definition (Hauser 2016). Suppose, for now, we decide to use the notion of human mind as soon as Principal G is available.

ii Chomsky (2006) repeatedly cites the expression 'mirror of mind' and ascribes it to the rationalist tradition, see p. xv and p. 67; also, Chomsky (1975, 4). As noted, this expression forms the basis for the title of this work. Unfortunately, I have been not been able to locate any direct rationalist source for this expression.

iii Similar remarks apply to the recently popular notion of 'the predictive mind' (Hohwy 2014) insofar as this approach in cognitive science studies the stable and largely accurate cognitive functioning of the brain in dealing with the sensory systems. This notion of 'predictive mind' certainly applies to nonhuman organisms, perhaps more so because that is all they've got for survival.

iv As we will see in Chapter Four, we are not talking of nonlinguistic thought such as musical thought, visual thought etc. We are talking of thoughts that are *expressed* in language, also called 'propositional thought'.